Experimental Physics - II
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Lecture - 26
Determination of the angle of minimum deviation for a given prism and hence to determine the refractive index of the given prism

next I will discuss another experiment. experiment 2 on prism basically.

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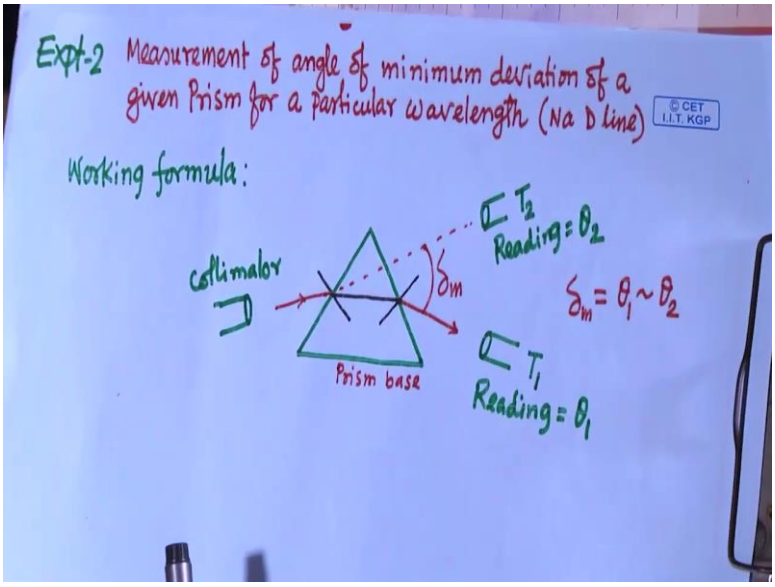

measurement of angle of minimum deviation of a given prism for a particular wavelength say sodium D line. if you use sodium source you will get yellow light. it tells call it is a D line it has particular wavelength. 5893 Angstrom for this wavelength, what is the angle of minimum deviation of a prism, that we would like to find out experimentally, ok.

then you have to put your prism on the prism table from collimator the parallel rays will fall on the prism, as we know that this you will get minimum deviation position when this refracted ray inside the prism will be parallel to the base of the prism, after putting the prism we have to change the incident angle rotating the prism. we have we will change the incident angle and look at the refracted emerging refracted rays and then we will see that that this is the deviation. minimum deviation means if this is the position for

minimum deviation; if I increase or decrease the incident angle, then this deviation will be higher than this one.

So; that means, these reflected rays emerging ray it will all the time for higher or lower incident angle, it will rotate this side, it will move this side. when I will rotate the prism clockwise also it will move this side or if I rotate anti clockwise also it will move this side. this position we have to find out first. that is the minimum deviation position and then after finding out the minimum deviation position.

we will put telescope here; we will put telescope here and take the reading. If take the reading in vernier 1 and vernier 2 if this reading is say theta 1 and then we will take that reading of the direct ray putting the telescope here, then I cannot get direct ray if I do not remove this prism table prism. I remove the prism then I will get direct reading

then if it is theta 2 then difference between theta 1 and theta 2 is this one; these will be the angle of minimum deviation. So, first, again for any experiment you have to find out the vernier constant for both Verniers; I am showing the same page ok.

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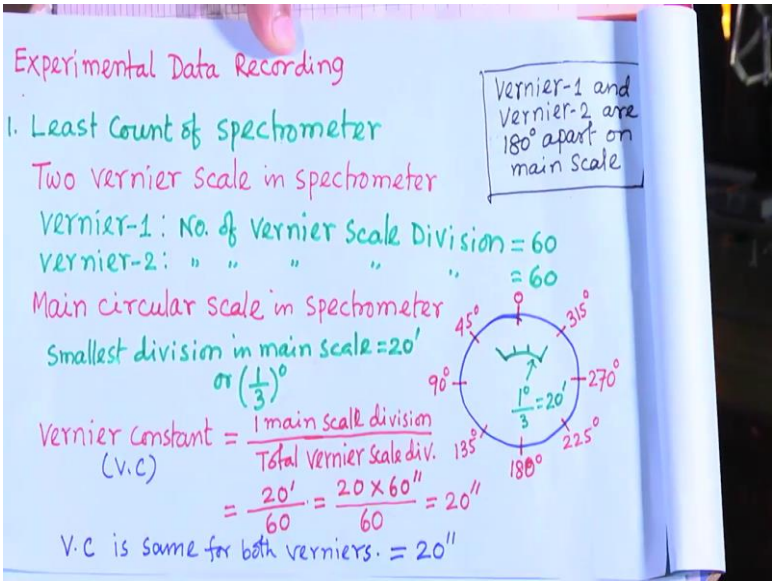

Already I have explained. for our case the vernier constant is 20 second for vernier 1 as well as for Vernier 2 that we have to note down.

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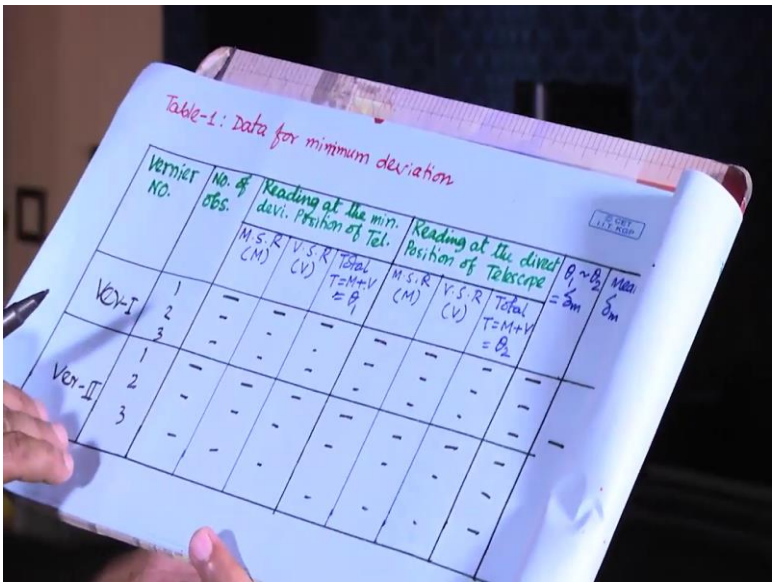

Then we have to go for the data recording or minimum deviation position. first, I have to set, I have to get minimum deviation position.

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I have taken the same prism. this is the apex, and this is the base you can guess from here. this is the collimator; this is the collimator you can see this collimator and the base of the prism almost is a parallel. this just from the figure you can guess. I will put prism like this ok this base is almost parallel to the collimator or incident rays. then the parallel rays from collimator will fall on the refracted surface, ok; this I will set this way put here

now, now I will change the angle of let me just yes let me look at them. when I will look for the emergent ray. you know that this is the normal to these and then rays are coming. this is the angle of incidence then it should be inside so this is the ray us coming inside it will be parallel to this base when it is at minimum deviation position and here; always these rays whatever these incident rays when refracted always it bends towards the base. this is my base this refracted ray it is towards the base.

I have to look in this angle and try to find out the minimum deviation, not minimum deviation this refracted rays emergent rays I have to I rotate this. it depends on practice you know little bit I can see it is this is the normal this surface I decrease is it height is ok, I do not think I have to put slightly height off, can you put off light switch off light, I got it I got it, but I took time. what I will do, I will see the; yes, so I got the emergent rays deviated rays, this is the direct rays after refraction I am getting this ray deviated ray in this direction, ok.

but it is not the minimum deviation position. I have to set it. I; what I have to do, I will just change the angle of incident angle. it is going back and if I change the other direction, it is going other direction it is coming back. I have to set the telescope it seems that is the minimum. now, if I rotate this way it is going back if I rotate this way also it is going back. minimum deviation position I have to actually one should lock it and use it for. and this also one can lock it and we can use the, to find out the fine screw you can use for locating exact minimum deviation position, yes, I think.

this is the minimum deviation position if I change the angle either increase the incident angle or decrease the incident angle. all the time these refracted rays this out going rays it is moving in this direction, I set the telescope at the minimum deviation position then at this position I have to note down the data, I have to note down the data. again, these data for minimum deviation vernier number vernier 1, vernier 2, then for again generally we take for each case three observation like earlier I have shown you; Vernier 1 and this is vernier 2, ok.

observation 1, what is the reading here one should note down main scale reading, vernier scale reading and then find the total, then take the reading from Vernier 2 observation 1 take the reading. Then again try to adjust it, again you try to adjust it minimum deviation position and check it and then arbitrary we will again take the reading; we will take the

reading, Set again the minimum deviation position take the reading, second set of reading from vernier 1, second set of reading vernier 2, second set of reading, ok.

Similarly, third set of reading one can take third set of reading one can take. this is the procedure to take the reading, taking reading is not difficult one should take now reading at the direct position of the telescope. now, what I have to do, I will take out the prism from here. I should not; this vernier scale should not move I keep it tightened the prism table only I will lose this telescope 1 and rotate it carefully.

that it should not; other one should not rotate carefully and come to the direct position; come to the direct position yes, yes I am tighten it and use the fine screw and make it coincide with the cross wire, Now this is the position and for this position direct position again you take the reading from vernier 1 and vernier 2, a set 1 note down the reading, And then again you adjust arbitrarily again you set at this direct position, set second set to minimize the error second set, then third set,

Then again take the difference of these 2. this is the direct and that was the deviated one and that deviation one it was the minimum deviation, I have two reading, now if I take difference of this 2 reading then I will get this angle of minimum deviation. theta 1 and theta 2 take difference I will get one data, second reading, third, then this again 6 reading I will get. And this more or less again you should check they will have only difference in second or minutes and then take average of this 6 data. that will be the, your minimum deviation position, this way one can measure the minimum deviation of a prism for a particular wavelength.

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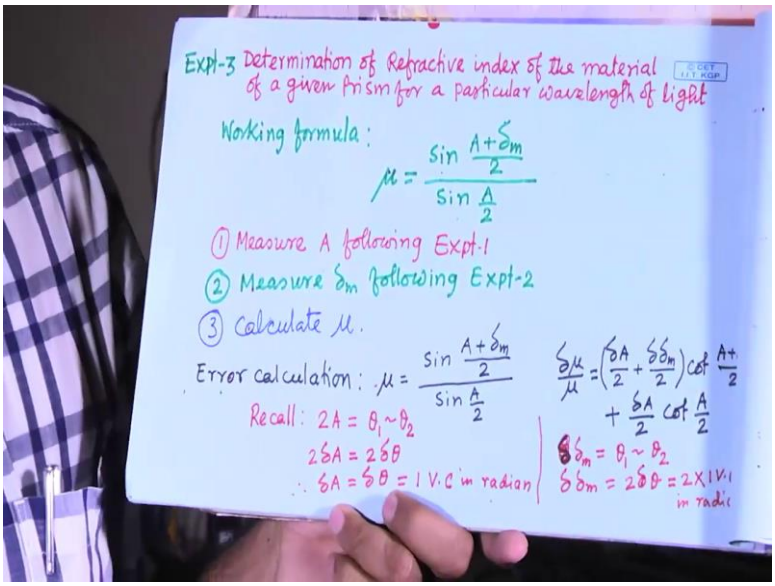

now third experiment determination of refractive index of the material of a given prism for a particular wavelength of light, working formula mu refractive index is equal to sin A plus delta m by 2 sin A by 2. this is the working formula for this experiment find out the refractive index, now to get the refractive index; what I have to know? I have to know the angle of the prism and also, I have to know the minimum deviation of the prisms. Angle of the prism does the different on the wavelength of the light, but minimum deviation; angle of minimum deviation it depends on the wavelength.

that is why this mu refractive index or m earlier I have used n. here also you can use n anyway I have used mu here. this refractive index is a function of wavelength that is why we have written for a particular wavelength of light. In this case the sodium D 1 line and wavelength is known to us. for this wavelength what is the refractive index ok; this is the working formula. experimentally we have to measure the angle of the prism and angle of the minimum deviation, ok.

measure a following the experiment 1 already we have done the experiment, you have data or do it, measure the minimum angle of minimum deviation following the experiment 2 just I described ok, then use this to calculate mu, that will be your refractive index. Now error calculation because here readymade formula we are using working formula. what is the error, most probable error percentage error one should calculate, here mu equal to this del mu by mu equal to you know this if you take log in

both side log mu equal to log of this plus log of this? then differentiate log of this means, del mu by mu and log of this means one by this and this differentiation of this one, ok.

one by this and differentiation of this one is cos it will be cot; it will be cot A plus delta m by 2. Now for this part that is delta A by 2 plus delta del of del m by 2 del of del m by 2 ok plus this part. 1 by sin A by 2 into this del of this means cos A by 2 cos by sin. this a cot A by 2 and for this part del A by 2. this is the del mu by mu equal to this, A and del m value is known to us, now what is del A and del of del m. that is you know the least count of the instrument.

Recall that when we measured this angle of prism. we have taken 2 reading theta 1 and theta 2, difference of theta 1 and theta 2 was this 2 A. 2 A equal to theta 1 minus theta 2, 2 of del A equal to del theta 1 and del theta plus del theta 2 means 2 del theta because least count was same for both cases. del A equal to del theta, equal to 1 Vernier constant; what is the Vernier constant, in radian yes you have to use in radian Similarly for del m, del m also how we got is the again, we have taken two reading theta 1 and theta 2. difference of theta 1 and theta 2 del of del m equal to del theta 1 plus del theta 2 means 2 del theta.

del of del m equal to 2 times of Vernier constant least count; whereas, for A it is one times of Vernier constant, why; that I explain here del A and del of del m is known to you and other A and del m is known to you. put here you find out del mu by mu into 100 that will give you percentage error, ok so for whatever we have discussed. how to measure the angle of prism? How to measure the angle of minimum deviation? And then we can calculate the refractive index of the material of the prism for a particular wavelength of light of course. I think I will stop here.

Thank you for your attention.