Experimental Stress Analysis - An Overview
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Lecture - 2.8
Different Polariscopes

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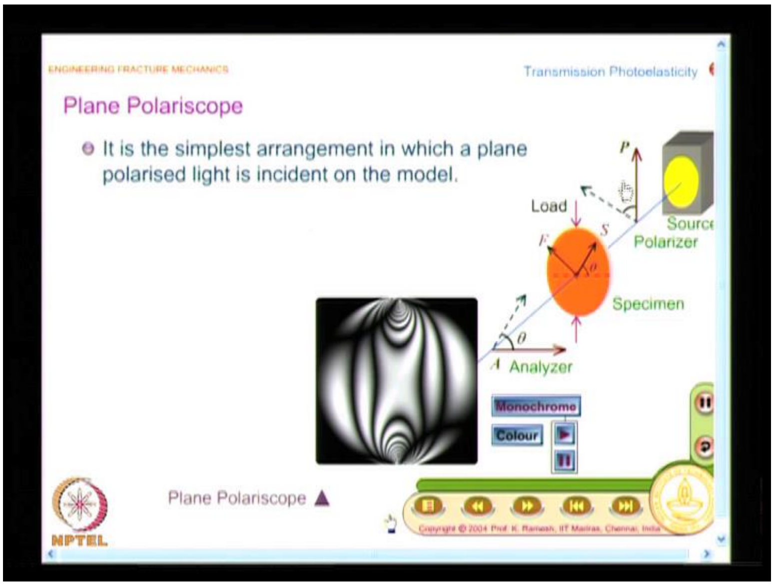

In this class, we will have a preliminary discussion on Different Polariscopes possible and their usefulness in getting different photo-elastic parameter. So what you find here, I have a polarizer, I have an analyzer, and I am sending a monochromatic light source and I have a model which is birefringent, which is loaded.

And what you find here? You have the background is still dark and within the region of the model you find fringe contours. Then what do you find here.

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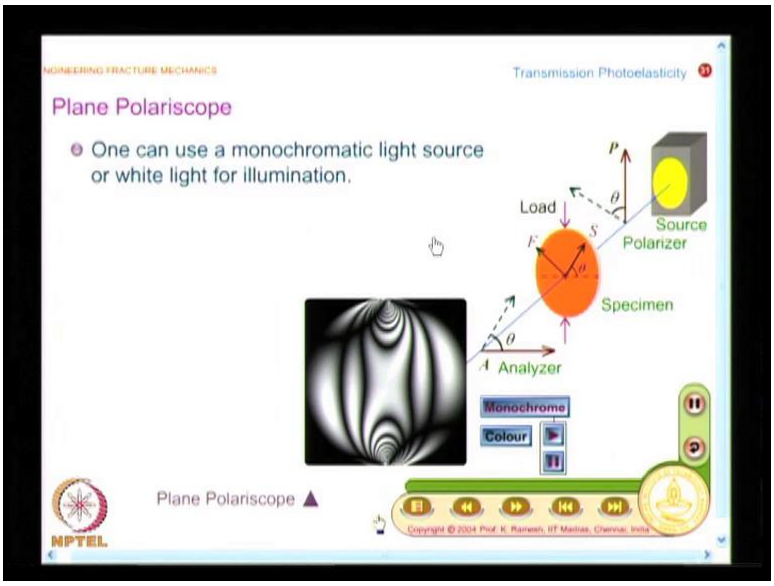

One can use a monochromatic light source or white light for illumination.

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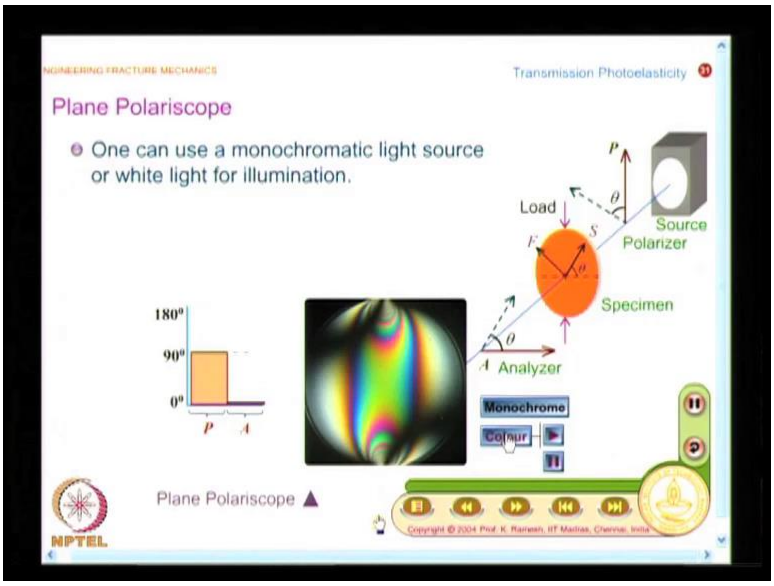

So, what I can do is it is a monochrome light source; I can also put white light source. What I find here is, when I put a white light which is nothing but light source of multiple wavelengths. Now, I find one set of contours are coloured the other two contour that we saw they still remain black. We will spend some time on looking at this again, we go to monochrome. Now the question is, I see as two dark bands here, are they same as these other dark bands or not.

What we will do is, we will now rotate the polarizer and analyzer combination, keeping them crossed. And let us see what happens. So now I rotate them. When I rotate them, what I find is one set contours remains stationary. These contours keep changing and they sweep the entire model, and what you have here is this dotted line show that you have the polarizer analyzer are rotated they are kept crossed. Now I go for a polychromatic light source, and as I said these are coloured, this I have not provided the reason, but this I have already provided when I rotate the polarizer analyzer you have this as a black contour. It is independent of wavelength.

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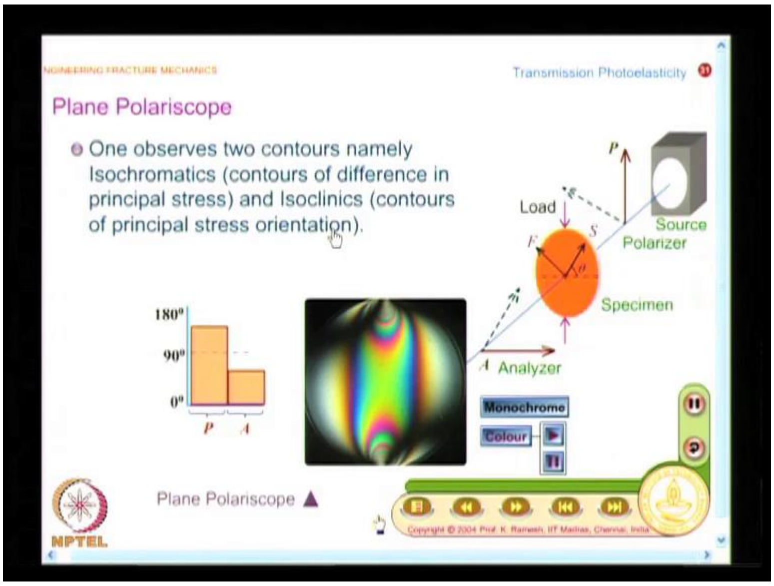

So what you have here is, in a plane polariscope, it is very clear now one observes 2 contours namely; Isochromatics, which show contours of difference in principal stress, and Isoclinics, they are nothing but contours of principal stress direction.

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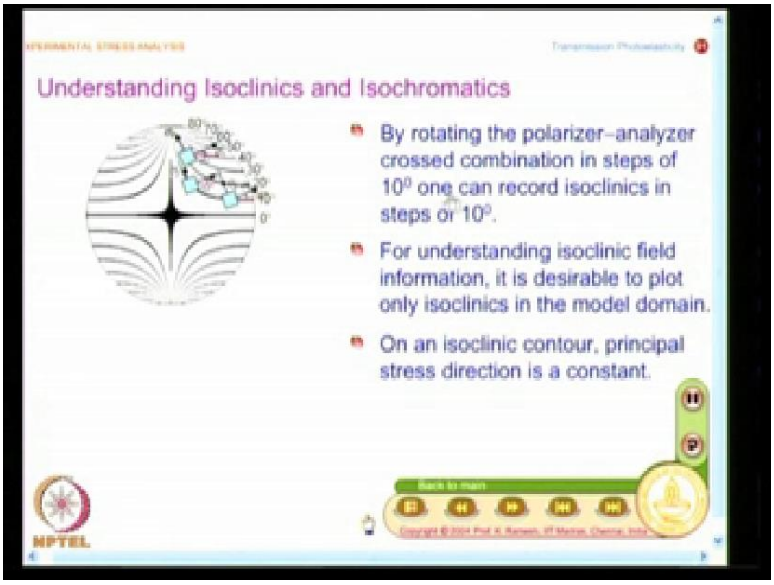

Look at what way we can represent. What I do is I rotate the polarizer analyzer crossed combination in steps of 10 degrees one can record isoclinics in steps of 10 degrees, and plot them. And what you have here is what is shown here is I have an isoclinic here which is labelled as 10 degree isoclinic and what you find here is sigma 1 and sigma 2 can have different magnitudes, but their orientation remains constant in this isoclinic. If I go to a 20 degree isoclinic the angle becomes 20 degrees. And, this you have to extract data by several different positions of the polarizer analyzer combination. You do not see this information available in one experimental exposure.

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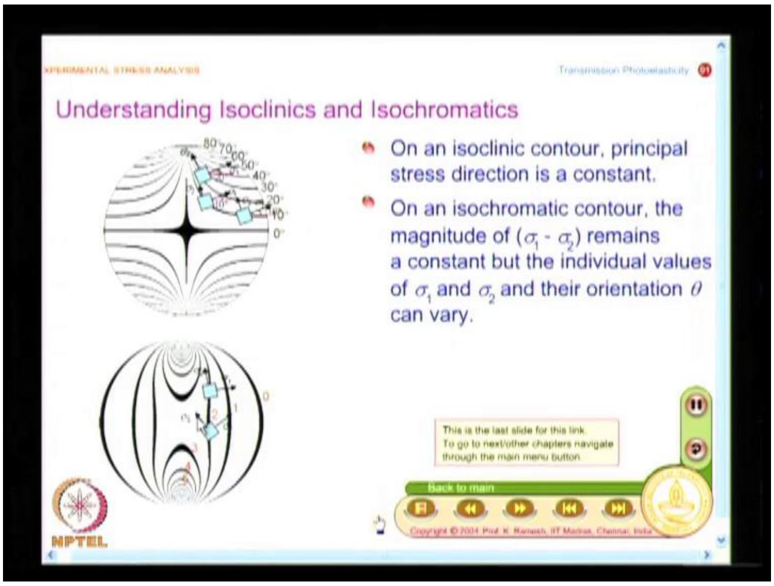

These are the isochromatics. And what you have here is, the direction may be different but the difference of sigma 1 minus sigma 2 will remain same on isochromatic contour, so that is only difference. Direction will remain not remain same here, direction will keep changing from point to point, but the difference of sigma 1 minus sigma 2 will remain same.

In a plane polariscope what we did, I have the source of light which is monochromatic, I have the first optical element as polarizer, then I have a loaded model, then I have the analyzer. When you see the screen, you see two sets of fringe pattern. So one observes 2 contours namely; isochromatics which represents contours of difference in principal stresses and isoclinics which represent contours of principal stress orientation.

Now, what we do? We go on look at what is the Circular Polariscope. Circular polariscope, I am going to have 2 additional elements, and what is the advantage of those 2 additional elements?

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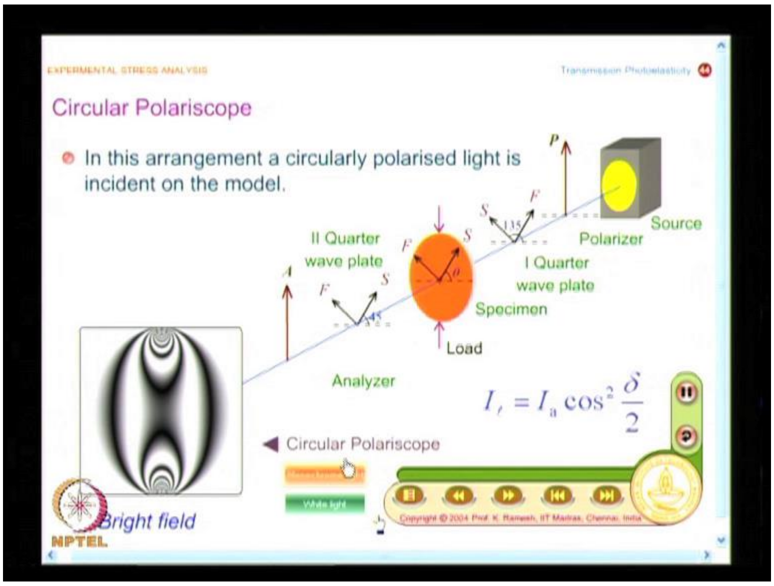

The two additional elements serve the purpose of removing the isoclinics. So what I have here is, I have a light source, I have a polarizer, I have a quarter wave plate, I have the model, then I have the second quarter wave plate, then I have the analyzer.

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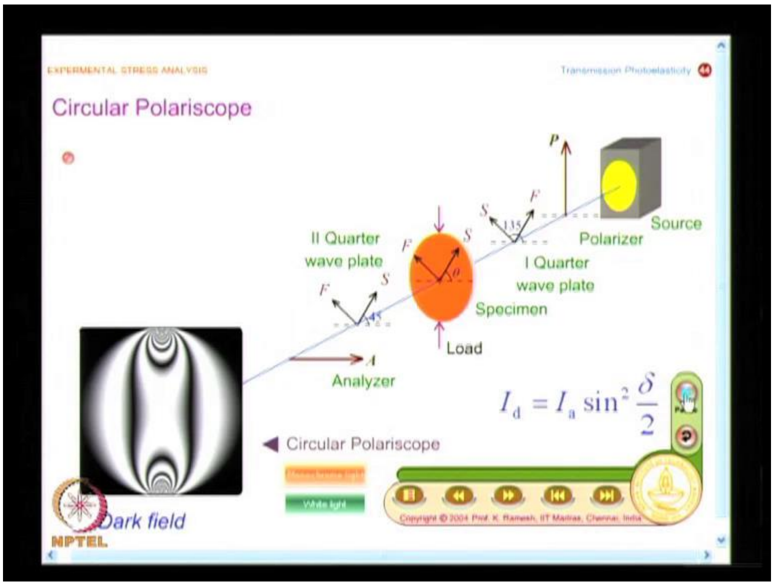

Suppose, I keep the analyzer horizontal, the quarter wave plates are crossed you also have the polarizer analyzer crossed and I see a dark field. Let us see a Commercial Polariscope now.

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This is a commercially available polariscope; this has a light source and what you have is a monochromatic light impinging on the model. You have the first optical element namely the polarizer. You have the second optical element which is the first quarter wave plate. Then you have the loading frame, in the loading frame you have the model loaded here you have a circular disk and a diametral compression. Then after the model you have the second quarter wave plate and finally, you have the analyzer.

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The advantage of a sheet polarizer is, you have a very large field of the order of 300 billimeters in dia, and they can be easily rotated by a simple mechanism. And what you see in the polariscope is the fringe patterns in dark field for a circular disk under diametral compressor. The fringes have to be labelled as 0, 1, 2, 3 etcetera. This shows the loading frame how the model is loaded and what you have is hydraulic cylinder, which is controlled by a pump by selecting the wall position appropriately.

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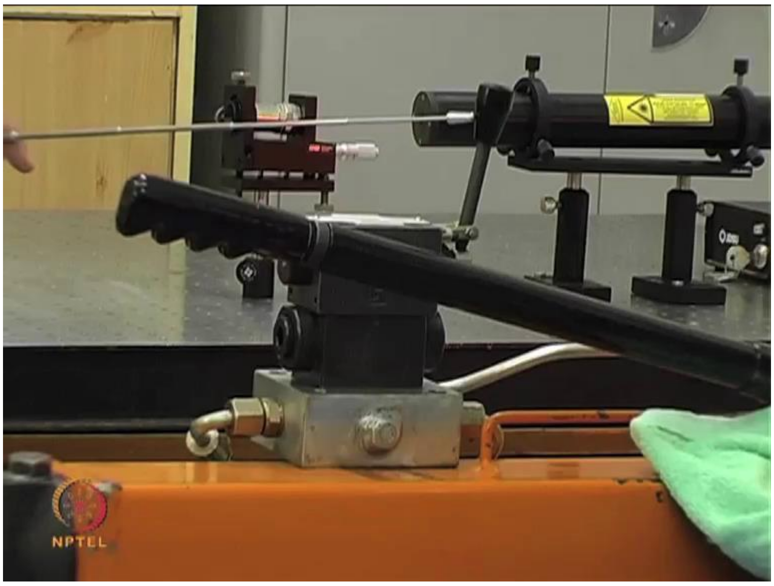

It is possible to change from tension to compression. And what I have here is a load cell which measures the load, and you have the model placed between 2 horizontal patterns and the disk is kept under diametral compressor.

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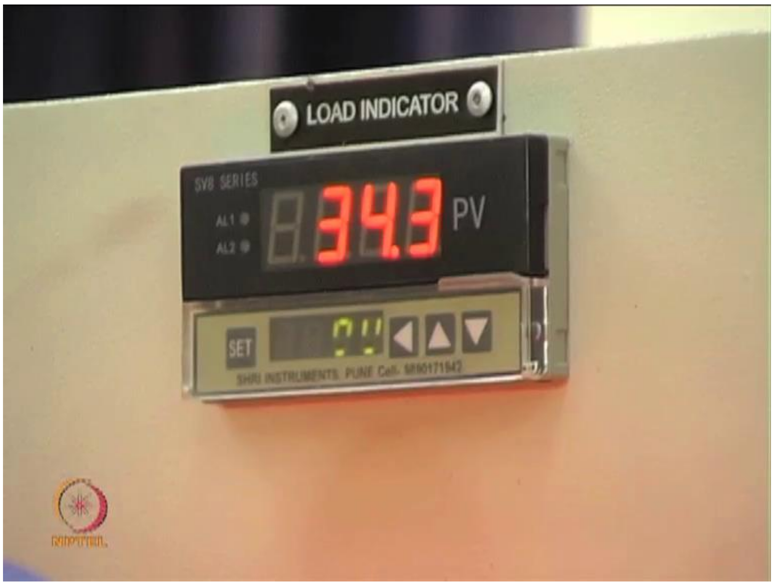

This shows the load that is applied and this reads it in kilogram force.

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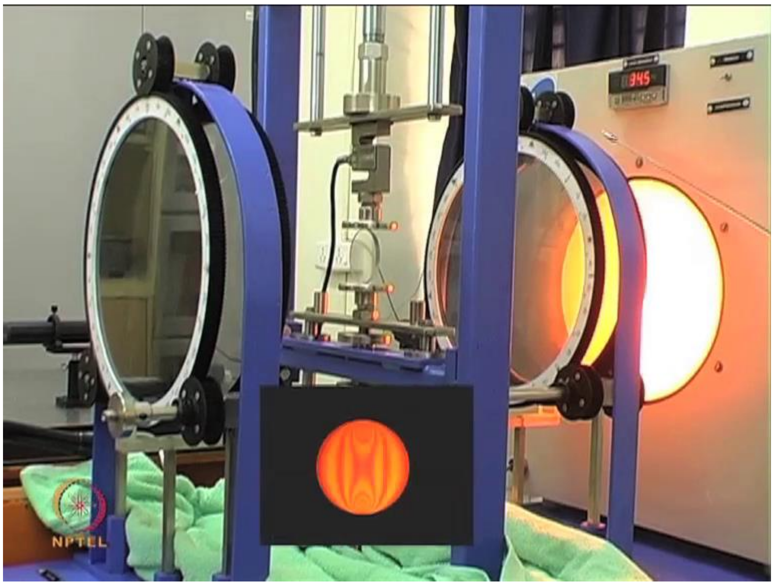

See the basic optical arrangement of the polariscope is in dark field. So what will have is, polarizer, analyzer are crossed, first quarter wave plate and second quarter wave plate are crossed. When you have both the pairs are crossed, you will essentially see a dark field. Suppose, I rotate the analyzer and keep it at 90 degrees, then what I will have is polarizer analyzer or parallel I will essentially see a bright field. Rotate the analyzer now.

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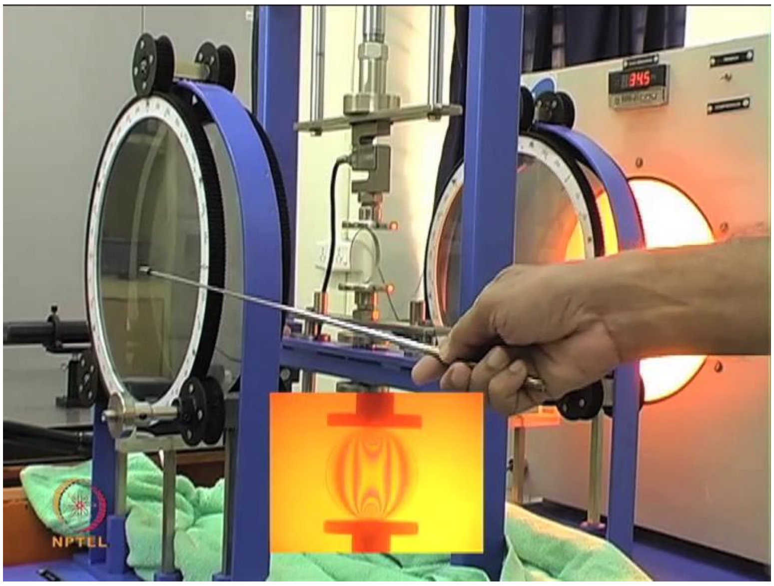

So what you now see is you see a bright field fringes. All the elements in the polariscope can also be rotated by this knob, and what you do this you use this for making this polariscope to function as a plane polariscope. In this what you do is you keep the quarter wave plate access along the polarizer so you optically cancel the first quarter wave plate. Similarly, optically cancel the second quarter wave plate. Now the polarizer analyzers are kept crossed and they can be rotated to find out the isoclinics in a plane polariscope.

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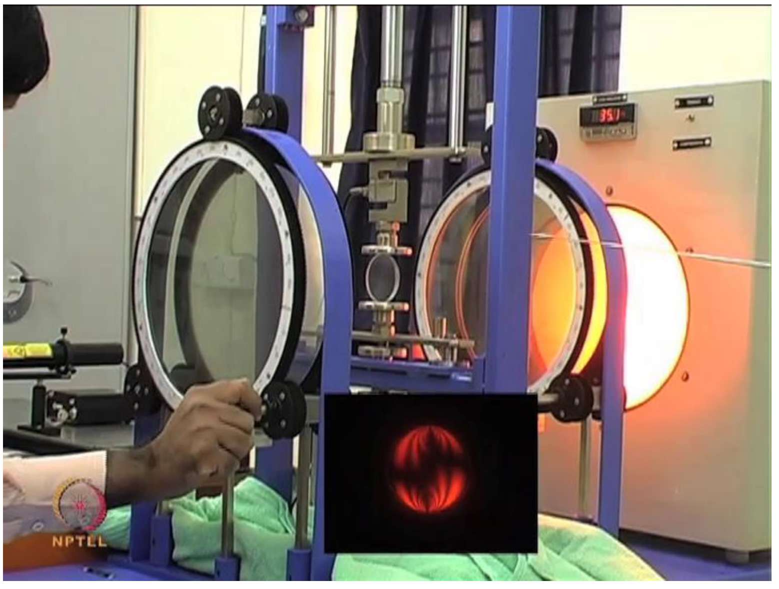

Rotate the (Refer Time: 10:19) now. You can now see all the elements are rotated appropriately. So you use can use this for plane polariscope as well as for circular polariscope.