Date:-
22/4/12

Babinet's Compensator

The Compensator is an optical instrument whose function is to compensate a path difference. It is used with a polarisor and analysor combination to investigate the elliptically polarised light. The construction and working of Babinet Compensator is given below:-

- **Construction:-**

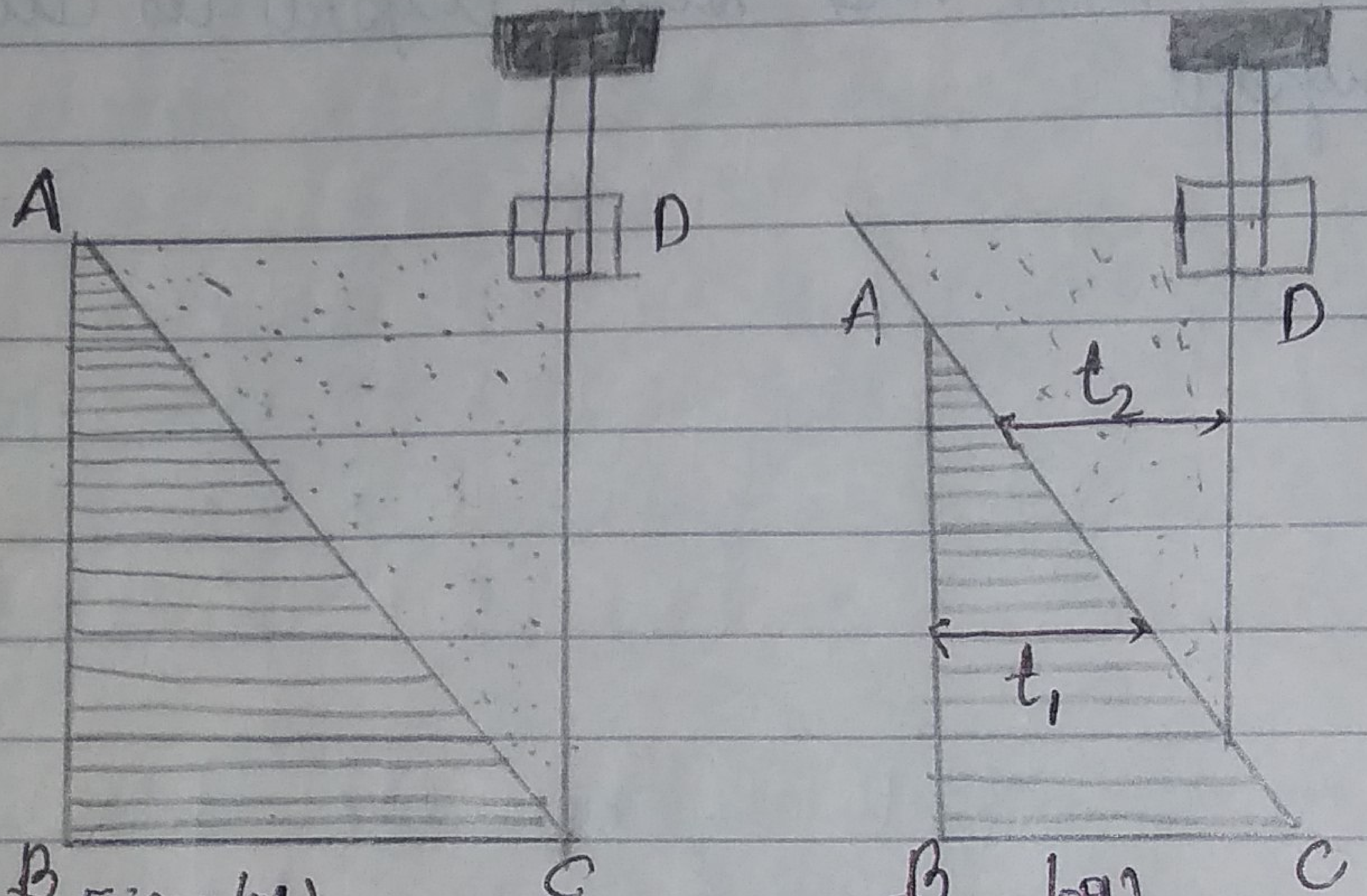

Figure (01) Figure (02)

The Babinet compensater is made up of two wedge shaped quartz ~~between~~ section ABC and ADC having same acute angle. The wedges are placed against each other such that they form a rectangular block as shown in figure ①

One of the quartz wedge is fixed and the other can be displaced along their plane of contact with the help of attached micrometer Screw arrangement. Therefore the combination 'X' as a plate of variable thicknes. All the arrangement are clearly indicated in the diagram

- **Working:-**

By the help of Babinet ~~Capon~~ compensator we can produce the polarised light which is described below.

Production of polarised light:-

First of all the plane polarised light be incident normally on the face AB of the compensator it splits into e-ray and o-ray parallel and perpendicular to AB respectively. We know that e-ray travells slower than o-ray in the first section because the quartz is a positive crystal when these ray enters into the second section when e-ray becomes o-ray and o-ray becomes e-ray therefore the two rays exchange their velocity in passing from one section to another section.

Therefore, the net effect is that the one section cancells the effect of the other.

Let 't_1' be the thickness of first section and μ_e and μ_o are the refractive index of e-ray and o-ray respectively then the path difference between these two rays in the first section can be written as

$$\Delta_1 = (\mu_e - \mu_o)t_1 \quad \text{--- (1)}$$

and the path difference between these two rays in the second section will be

$$\Delta_2 = (\mu_o - \mu_e)t_2 \quad \text{--- (2)}$$

$\therefore$ Total path difference between the two rays after emerging from the crystal can be written as

$$\Delta = \Delta_1 + \Delta_2$$

$$= (\mu_e - \mu_o)t_1 + (\mu_o - \mu_e)t_2$$

$$\Delta = (\mu_e - \mu_o)t_1 - (\mu_e - \mu_o)t_2$$

$$\Delta = (\mu_e - \mu_o)(t_1 - t_2) \quad \text{--- (3)}$$

It is to be noted that when the compensator having the same thickness i.e. $t_1 = t_2$ then the Total path difference and Hence the phase difference and Hence the phase difference becomes zero. It means the effected of one wage is exactly cancelled by the other.

But to produce the polarised light we desired there is a difference between $(t_1 - t_2)$, it can be at the centre of the compensator by moving the second section relative to the first section. Therefore any desired value of between e-ray and O-ray can be obtained. Therefore the light emerging will be either plane, or circularly or elliptically polarised light depending on the phase difference.

The Condition of the phase difference of plane polarised light, circularly polarised light or elliptically polarised light can be obtained by varying the thickness of the plate.

Analysis of Polarised light:-

By using the Compensator one can determine the characteristics of polarised light for this we have made the following experimental arrangement.

- Experimental arrangement:-

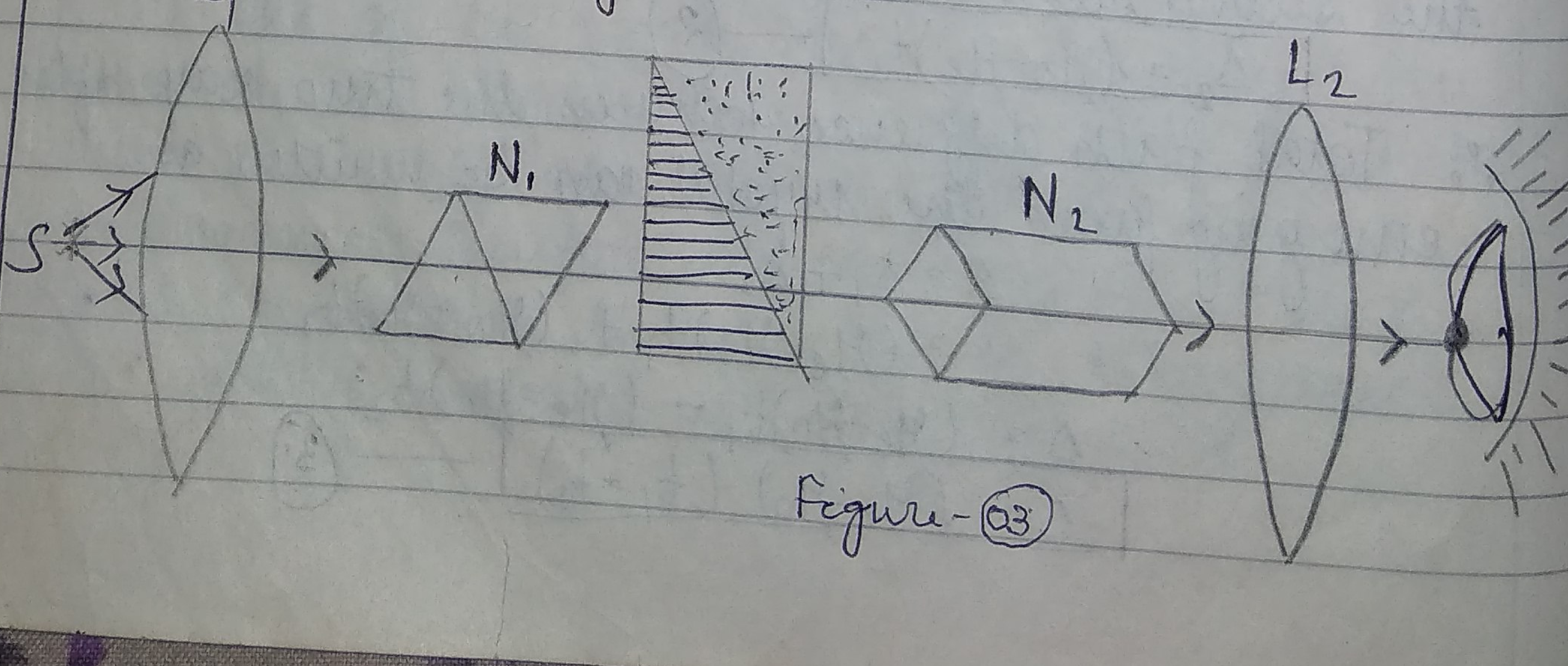

Figure-03

In this experimental arrangement the Babinet compensator is adjusted between the analyser N_1 and polariser N_2 in which the analyser N_1 is rotated about its own axis with a constant different phase difference. The ordinary light of the source 'S' passing through the lens L_1 and incident on the analyser N_1

First of all the analysor N_1 is rotated and fixed having the phase diff 0° or 180° then the ray is incident on the compensator 'C' and splits up into O-ray and e-ray combined to each other having the phase difference 0° or 180° hence the emerging light satisfied the condition of plane polarised light which is observed by polarisor N_2.

In the similar way the condition of elliptically polarised light and circularly polarised light can be achieved by rotating the analyser N_1 and which is incident on the compensator as discussed above. Hence the emerging light becomes elliptically or circularly polarised light with their own condition and observed by the polariser N_2.

In this way we can produce and detect the polarised light by the help of Babinet Compensator.