National Anveshika Experimental Skill Test -2021

(NAEST – 2021)

Name:.....Class.....

Roll NO.....Mobile No.....

School/College Name.....

Date.....Time.....

SF3- Refractive Index of glass for Red and Blue light

Background:

For a convex lens $\frac{1}{f} = (\mu - 1)\left(\frac{1}{|R_1|} + \frac{1}{|R_2|}\right)$

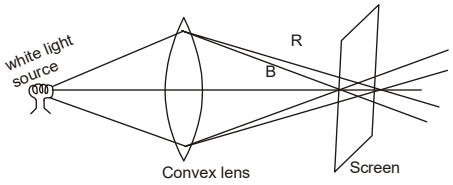

Figure-1

Also $\frac{1}{f} = \frac{1}{|v|} + \frac{1}{|u|}$ for real images

By measuring radii R_1, R_2 and $|v|, |u|$ one can get the refractive index μ.

White light from an ordinary incandescent bulb/ white LED has a spectrum of different wavelengths and the refractive index is different for different wavelengths. Correspondingly, different colours will have different places of focusing. Thus, a convex lens not only makes an image of an object, it also disperses the light according to the colour. In this experiment, you will use a glowing LED as an object and find the u-v data for red and blue components of light. From this you will find refractive indices of the glass for these colours.

In order to reduce the effect of spherical aberrations, the central part of the lens is covered and only the outer part of the lens is allowed to pass the light.

Materials:

A measuring tape fixed on the table, a lens stand, a lens, two glass slabs, graph sheet, black paper, a glue stick, scissor, a screen, 30 cm scale, a white LED fitted in a stand, and DC Power supply.

Experiment

PART A: Finding the radius of curvature of the lens surfaces

A double convex lens is given to you. Assume that both the surfaces have same radius of curvature. The shape of the lens is sketched in Figure-2. The measurable quantities are shown in Figure 2

(a)Thickness at the middle 2h, (b) thickness at the end 2a, and (c) the radius d. You can do some geometrical calculations to the find the expression for the radius of curvature as

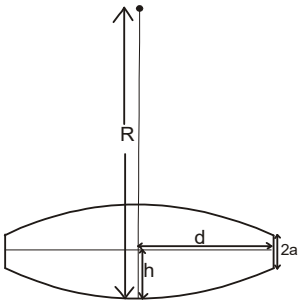

Figure-2

$$R = \frac{d^2 + h^2 + a^2 - 2ah}{2(h-a)}$$

To get 2h or 2d, you can put the lens between the two glass slabs placed on a graph sheet and measure the separation between the slabs. To get 2a, you can use the plastic scale. If you come up with a better way, you are welcome to use that.

PART B: Getting u-v

Estimate roughly the focal length f of the convex lens. Cut a circular piece of black paper of proper size and paste it on the central part of the lens leaving about 5-6 mm wide ring at the periphery.

Put the lens in the stand. Put the LED, screen and the lens in a line. Let the distance between the screen and the lens be around 1.5 f.

Put the LED at some distance from the lens and change it. Try to focus the image of the LED on the screen. Check that the image has colours in it.

Adjust the position of the LED so that the red light is just focused on the screen. Blue will be surrounding the center. Measure the distances u and v accurately.

Adjust the position of the LED so that the blue light is just focused on the screen. Red will be surrounding the center. Measure the distances u and v accurately.

Calculate the focal length of the lens for the blue light and for the red light from the measured u and v. Find μ_b and μ_r from the data.

Find the possible uncertainty in the results.

Estimate of Errors/ Extensions / Comments