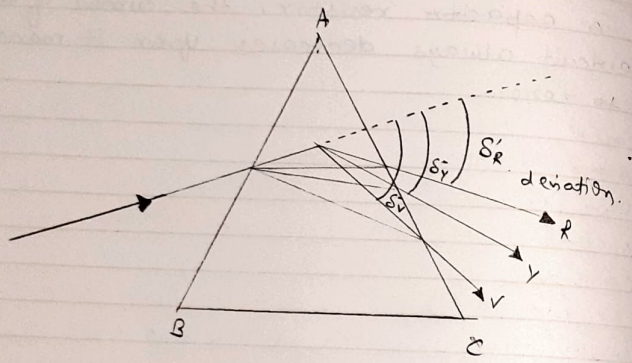

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Experiment No.

Object :- To determine the dispersive power of the material of Prism by spectrometer.

Apparatus :- Spectrometer, prism, spirit level, reading lens and mercury lamp.

Theory & formula :- A spectrometer is an instrument used to measure and record light waves over a part of the electromagnetic spectrum (line spectra). It determines the line spectrum of various light sources, materials and even elements. The spectrometer is also a tool for examining which parts of white light are absorbed by materials.

The dispersive power of the material of a Prism is given by

$$\omega = \left(\frac{\mu_V - \mu_R}{\mu_Y - 1}\right)$$

where μ_V = Refractive index of the material of a prism for extreme violet colour.

μ_R = Refractive index of the material of a prism for extreme red colour

μ_Y = Refractive index of the material of a prism for yellow (mean) colour position.

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Calculations

- Prism Angle A = 60°
- Minimum Deviation (D_m)

- Refractive index for violet, yellow and red colours is

For violet

$$\mu_v = \frac{\sin(A+D_m)/2}{\sin(A/2)}$$

$$\mu_v = \frac{\sin(60+51.25)/2}{\sin 30}$$

$$\mu_v = 0.82 \times 2 = 1.640$$

For Red

$$\mu_r = \frac{\sin(A+D_m)/2}{\sin(A/2)}$$

$$\mu_r = \frac{\sin(60+49.69)/2}{\sin 30}$$

$$\mu_r = 1.635$$

For Yellow

$$\mu_y = \frac{\sin(A+\delta_m)/2}{\sin(A/2)}$$

$$\mu_y = \frac{\sin(60+49.103)/2}{\sin 30}$$

$$\mu_y = 1.629$$

Now, Dispersive power of prism ω

$$\omega = \frac{\mu_v - \mu_r}{\mu_y - 1}$$

$$\omega = \frac{1.640 - 1.635}{1.629 - 1}$$

$$\omega = 0.0079$$

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Refractive index is given by

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin(A/2)}$$

where A = Angle of Prism (in degree)
δ_m = Angle of minimum deviation (in degree)

Observation :- For Prism angle:

Least count of vernier scale is = $\frac{1}{60} = 0.016$

For minimum deviation D_m

S.N	Color of Spectrum	Vernier	Dispersive Image			Direct image			$D_m = \lvert a-b \rvert$	Mean D_m
			M.S.	V.S	T.R. (a)	M.S	V.S	T.R. (b)		
1.	Violet	V_1	119	10	119.16	170.5	5	170.58	51.42	51.258
		V_2	299	4	299.064	350	10	350.16	51.096	
2.	Yellow	V_1	120.5	5	120.58	170.5	5	170.58	50.00	49.69
		V_2	300.5	18	300.78	350	10	350.16	49.38	
3.	Red	V_1	121	4	121.064	170.5	5	170.58	49.51	49.103
		V_2	301	29	301.464	350	10	350.16	48.696	

Result

The dispersive power of material of a Prism $\omega = 0.0079$

Precaution :-

1. The slit should be as narrow as possible but the knife-edges of the slit should not touch each other.
2. The telescope and the collimator should be separately set for parallel rays.
3. The height of the prism table should be so adjusted that the maximum light must fall on the entire surface of the prism.
4. While taking observations the telescope and the prism table must be clamped.
5. The reading lens should be used for taking readings on both the verniers.

Industrial Application :-

1. Prism is widely used in devices like Binoculars, Periscope, Cameras, Grating etc.
2. To find the refractive index of any transparent medium.

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Viva Questions:-

Q1 What do you mean by interference of light?

Ans When the two waves superimpose over each other, resultant intensity is modified. The modification in the distribution of intensity in the region of superposition is called interference.

Q2. What is refractive index?

Ans The ratio of the sine of the angle of incidence to the sine of angle of refraction is constant of any two media, known as refractive index.

Q3. Is it essential in your experiment to place the prism in the minimum deviation position? if so, why?

Ans Yes, it is essential because we obtain a bright and distinct spectrum and magnification is unity i.e. the distance of the object and image from the prism is same. The rays of different colours after refraction diverge from the same points for various colours.

Q4 What does the angle of minimum deviation vary with the colours of light?

Ans Yes, it is minimum deviation for red, and maximum for voilet colour.

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Q5. Will the angle of minimum deviation change, if the prism is immersed immersed in water?

Ans Yes, the refrective index of glass in water is less than air hence angle of minimum deviation becomes less.

Q6 Does the deviation not depend upon the length of the base of the prism?

Ans No, it is independent of the length of the base. By increasing the length of base, resolving power is increased.

Q7 What do you mean by pure spectrum?

Ans A spectrum in which there is no overlaping of colours is known as pure spectrum. Each colour occupies a separate and distinct position.

Q8 Can you determine the refractive index of a liquid by this method?

Ans Yes, the experimental liquid is filled in a hollow glass prism.

Q9 How refractive index vary with the wavelength?

Ans Higher is the wavelength, smaller is the refractive index.

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10. What is the relationship between deviation & wavelength?

Ans = Higher is deviation, smaller is wavelength i.e. deviation for violet colour is must but wavelength is least.

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