Assignment-10 Experiment-10

DETERMINATION OF LASER PARAMETERS – DIVERGENCE   AND WAVELENGTH FOR A GIVEN LASER SOURCE USING LASER GRATING

AIM

To determine the divergence and wavelength of the given laser source using standard grating.

APPARATUS REQUIRED

Laser source, grating, a screen etc.,

PRINCIPLE

When a composite beam of laser light is incident normally on a plane diffraction grating, the different components are diffracted in different directions. The mth order maxima of the wavelength λ, will be formed in a direction θ if $d \sin \theta = m\lambda$, where d is the distance between two lines in the grating.

FORMULA

1.   The angle of divergence is given by

$$\Phi = \frac{(a_2 - a_1)}{2(d_2 - d_1)}$$

where a_1 = Diameter of the laser spot at distance d_1 from the laser source

a_2 = Diameter of the laser spot at distance d_2 from the laser source

2.   The wavelength of the laser light is given by

$$\lambda = \frac{\sin \theta_m}{Nm} \quad m$$

where m   =   Order of diffraction
θ_n =   Angle of diffraction corresponding to the order m
N   =   number of lines per metre length of the grating
θ = $\tan^{-1} (x/D)$
x   =   Distance from the central spot to the diffracted spot (m)
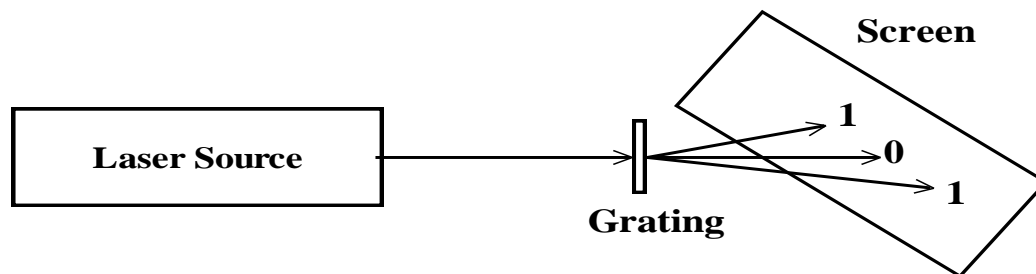D   =   Distance between grating and screen(m)

Fig. 11.1a Experimental Setup for Laser Grating

Table 11.1a: Determination of wave length of Laser Light:

Distance between grating and screen (D) = 30 cm

Number of lines per metre length of the grating = N = 10^5 lines/m

S. No	Order of Diffraction (m)	Distance of Different orders from the Central Spot (x) m		Mean (x) m	Angle of diffraction $\theta = \tan^{-1}[x / D]$	$\lambda = \dfrac{\sin \theta_m}{Nm}$ Å
		Left	Right			
1	1	1.9	1.9	?	?	?
2	2	3.9	3.9	?	?	?
3	3	5.9	5.9	?	?	?
4	4	7.9	7.9	?	?	?
5	5	10	10	?	?	?

Mean: …….Å

Observation:

d₁=20 cm, a₁=0.4 cm, d₂=40 cm, a₂=0.5 cm

Assignment Question:

1. Find the difference between the diameter of the laser spot a_1 and a_2 and the distance d_1 and d_2 and substitute the values in the formula to calculate the angle of divergence and enter the answer in your observation note book.

2. From the order of diffraction readings, find the mean value between Right and Left, and enter the values (x) in the respective coloum in the observation note book.

3. From the readings (x, D) in the tabular coloum to calculate the angle of diffraction (θ) using the formula and enter the values in respective oloum in your observation note book.

4. From the readings (N, m and θ) in the tabular coloum to calculate the wavelength of the laser light using the formula and enter the values in last coloum of the tabular coloum in your observation note book.

5. Write the result in the following order

The angle of divergence is ………..

The wavelength of the given monochromatic source is …………..

Finally, submit the scanned copy of your observation note book in GCR on (or) before THREE working days from the date of experiment.