Department of Physics

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Application No: 22BTRAD018

EXP – 5 LASER DIFFRACTION

Aim: To Determination wavelength of given laser light

Apparatus: Diffraction grating, Laser source, grating stand, screen.

Formula:

$$\lambda = \frac{2C \sin\frac{\theta}{2}}{n}$$

Where , C, is grating constant (m)

Θ, is the angle of diffraction(deg)

n, is order of diffraction

λ, is the wavelength of the laser light used (m)

The angle of diffraction θ is given by

$$\theta = \tan^{-1}\frac{x}{f}$$

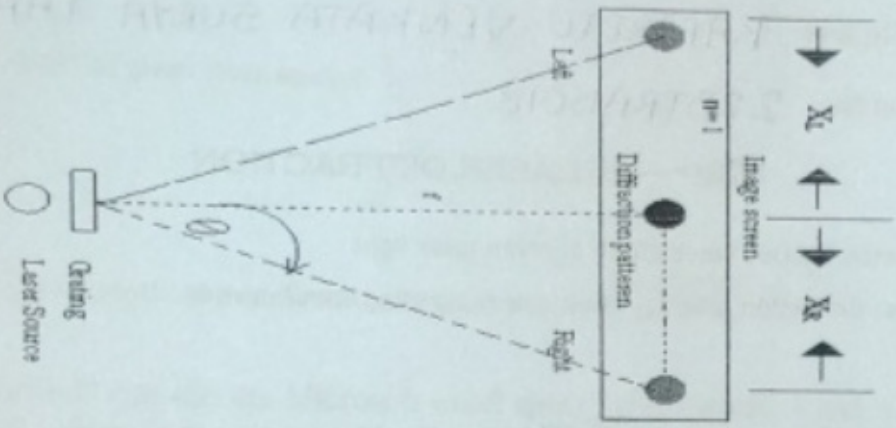
Where, 'x' is the distance between the central maxima and secondary maxima.

'f 'is the distance between the image and the grating.

Procedure:

The laser source is placed on a table and switched on. The leveling screws of the laser are adjusted such that the laser beam exactly falls on center of graph sheet placed on the screen, which is placed at about 1m from the laser source. The diffraction grating is now placed on grating stand close to the laser source. The diffracted laser spots are observed on either side of central maximum. The central maximum is very bright and as the order of diffraction increases the brightness decreases. The center of various spots of the diffraction pattern are marked using a pencil, then the graph sheet is removed from the screen and the distances between central maxima and various diffracted spots are measured on either side of central maximum. Diffraction angles are calculated for various orders of diffraction. The wavelengths of laser for various orders of diffraction are calculated using given formula and the average wavelength is obtained.

Observations:



Tabular column:

Sl. No.	Order of spectrum (n)	Distance from central maximum (cm)		Mean distance $X_n = (X_L + X_R)/2$ (cm)	θ_n (deg)	λ(m)
		LHS (X_L)	RHS (X_R)			
1	1	1.05	1.1	1.075	0.0134	6.825×10^{-7}
2	2	2.1	2.2	2.15	0.0268	6.824×10^{-7}
3	3	3.1	3.1	3.1	0.0387	6.55×10^{-7}
4	4	4.2	4.2	4.2	0.0524	6.660×10^{-7}
5	5	5.3	5.2	5.25	0.065	6.656×10^{-7}
6	6	6.3	6.2	6.25	0.077	6.599×10^{-7}
7	7	7.5	7.3	7.4	0.092	6.691×10^{-7}
8	8	8.5	8.4	8.45	0.105	6.679×10^{-7}

Mean λ = 6.68698×10^{-7} (m)

Calculations:

Distance between the grating and screen, f = 80 cm

The angle of diffraction, $\theta = \tan^{-1}\frac{x}{f}$ = 0.059057211 (rad)

The distance between two consecutive rulings on grating K = 500 LPI

No of lines per meter on grating, $N = \frac{K}{2.54 \times 10^{-2}}$ = 19685.03937

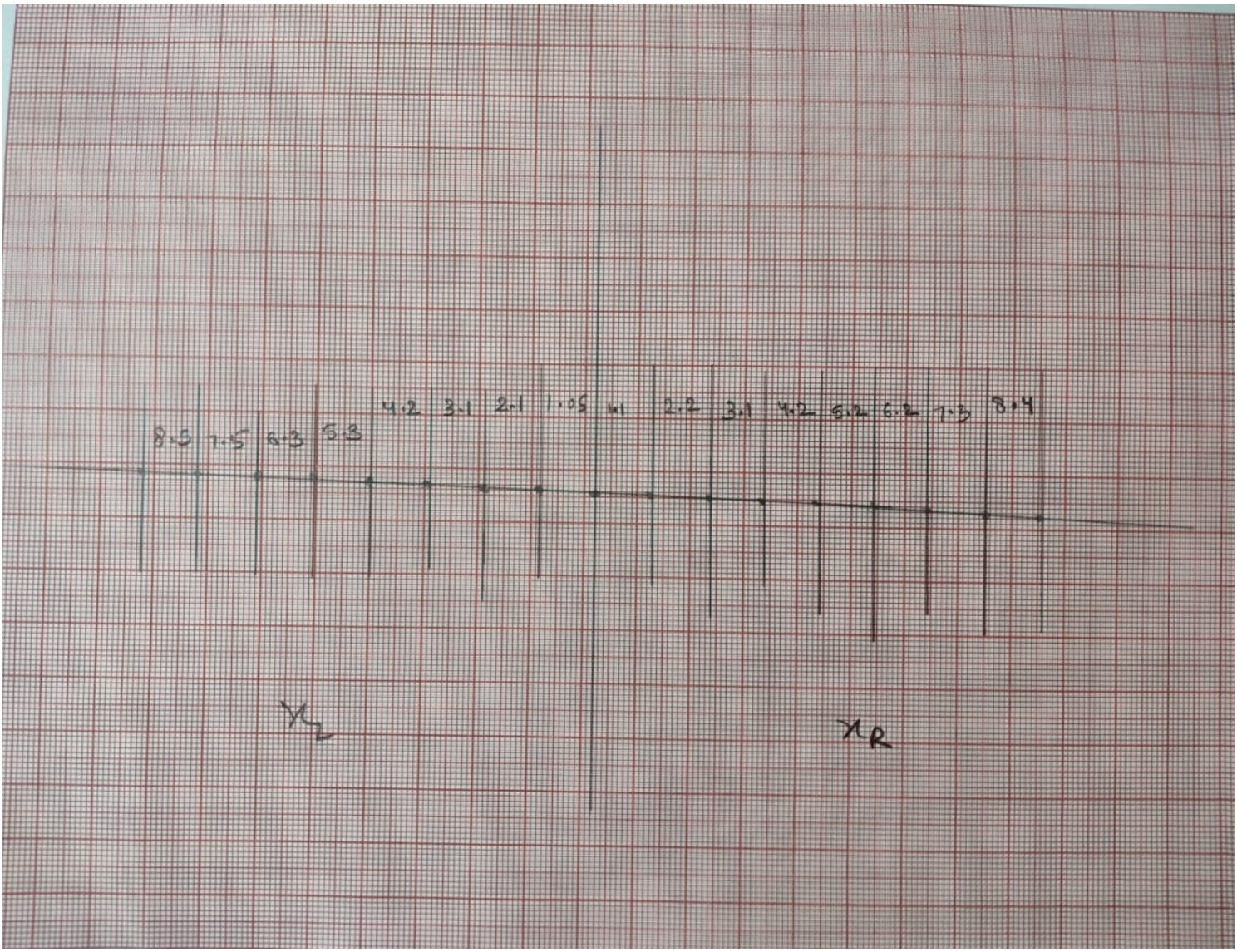
Grating constant, $C = \frac{1}{N} =$ 0.0000508 m

The wavelength of given laser source, $\lambda = \frac{2C \sin\frac{\theta}{2}}{n}$

$\lambda =$ 6.686×10^{-7} m

Result: Wavelength of the given laser source is $\lambda =$ 6.6869×10^{-7} m

Note: Students can use the Microsoft excel sheet for calculations and paste the calculated values in the above table. Send the completed file in **pdf format** to your course teacher.


8.5
7.5
6.3
5.3
4.2
3.1
2.1
1.05
1
2.2
3.1
4.2
5.2
6.2
7.3
8.4
$\bar{X}_L$
$\bar{X}_R$