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Expt. No. 2 — Monochromators in Sophisticated Instruments — Page No. 3

Apparatus Available :-

1. Laser source
2. Grating
3. Scale with measurements

Objective :-

To determine the wavelength of the given laser source using transmission diffraction grating method

Basic Information :-

D = distance from grating to the screen
d = spacing between every 2 lines (same thing as every 2 sources)

If there are any (N) lines per mm of the grating, then (d), the space between every 2 adjacent lines or (every 2 adjacent sources) is

$$d = \frac{1}{N}$$

The diffraction grating formula for the principal maxima is :

$$d \sin\theta = n\lambda$$

where n is the order of diffraction (= 1, 2, 3 ....) & θ angle of diffraction

$$\lambda = \frac{\sin\theta}{Nn} \text{ (meter)}$$

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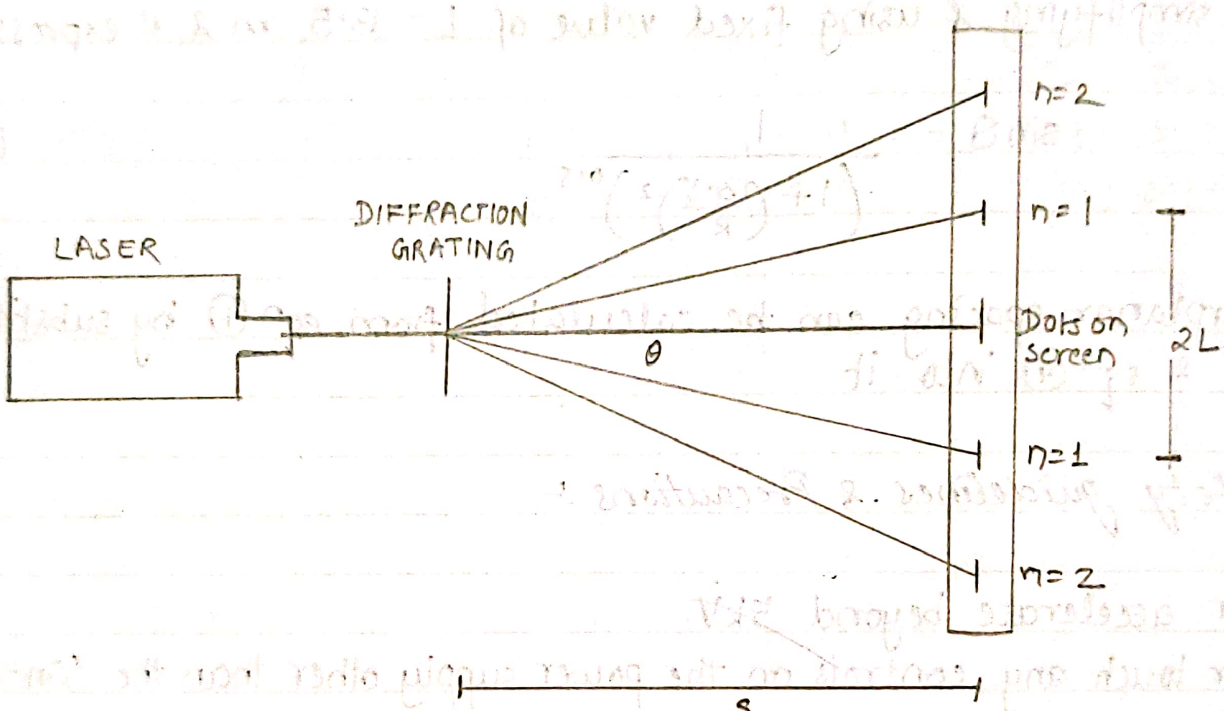

Experimental setup

n	S(cm)	2L(cm)	L(cm)	$\tan\theta = L/S$	$\theta = \tan^{-1}(L/S)$	$\sin\theta$	Mean	λ(nm)
1	30	4	2	0.0666	3.814	0.0665	0.0673	0.0673×10^{-5}
	35	4.8	2.4	0.0685	3.922	0.0683		
	40	5.4	2.7	0.0675	3.861	0.0673		
2	30	8	4	0.1333	7.594	0.1321	0.1312	0.0656×10^{-5}
	35	9.2	4.6	0.1314	7.487	0.1303		
	40	10.6	5.3	0.1325	7.547	0.1313		
3	30	12	6	0.2000	11.309	0.1961	0.1968	0.656×10^{-5}
	35	14	7	0.2000	11.309	0.1961		
	40	16.2	8.1	0.2025	11.447	0.19846		

$N = 10^5$

$$\lambda_{mean} = \frac{(0.0673 + 0.0656 + 0.0656) \times 10^{-5}}{3}$$

$$= 0.0661 \times 10^{-5}$$

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Result :-

The wavelength of the laser source is found to be 0.0661×10^{-5} nm

661 nm

Calculations :-

n = 1

$$\text{Mean} = \frac{(0.0665 + 0.0683 + 0.0673)}{3} = 0.0673$$

n = 2

$$\text{Mean} = \frac{(0.1321 + 0.1303 + 0.1313)}{2} = 0.1312$$

n = 3

$$\text{Mean} = \frac{(0.1961 + 0.1961 + 0.1984)}{3} = 0.1968$$

"λ"

$n = 1$; $\lambda_1 = \frac{0.0673}{10^5 \times 1} = 0.0673 \times 10^{-5}$

$n = 2$; $\lambda_2 = \frac{0.1312}{10^5 \times 2} = 0.0656 \times 10^{-5}$

$n = 3$; $\lambda_3 = \frac{0.1968}{10^5 \times 3} = 0.0656 \times 10^{-5}$

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