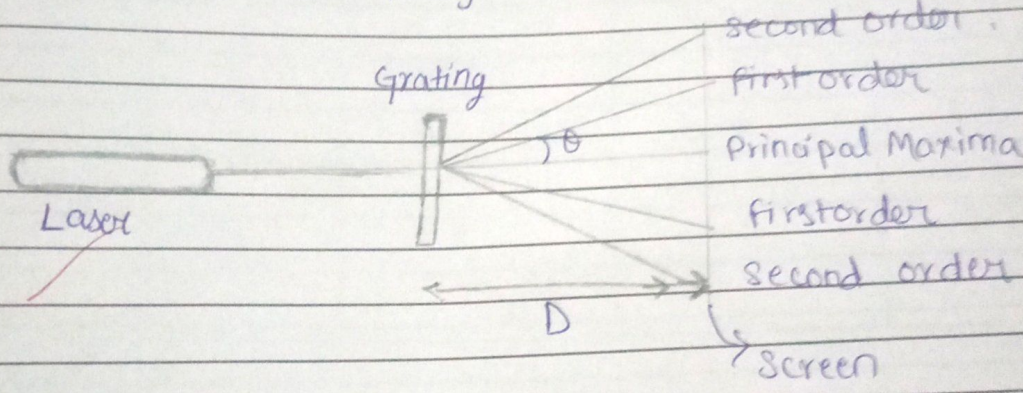
PRACTICAL - 4

Laser wavelength determination using multiple slits (virtual)

Aim: To determine ~~the~~ laser wavelength using multiple slits (Diffraction Grating)

Apparatus: Laser source, Grating Plate, screen, scale

Diagram:



~~form~~

formula: Condition for diffraction maxima is given by:

$$d\sin\theta = n\lambda \quad \& \quad d = \frac{1}{N}$$

where,

d = Grating element
θ_n = Angle of n^{th} order diffraction
λ = Wavelength of incident light
n = diffraction order
N = Number of lines on grating

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- Observation :

Number of lines grating = N = 400 lines per m

N = 4000 × 10^{-6} per m

- Observation Table

Sr. No.	Distance b/w grating & system (D)	Order	Distance b/w center & right maximum (a) (m)	Dist b/w center & left maximum (b) (cm)	Mean dist $x = \frac{a+b}{2}$
1	100	1	3.0	3.2	3.1
2	100	2	0.2	6.4	6.3
3	100	3	9.5	6.6	9.55

- Procedure

1. Start the virtual lab simulation using the link.
   Link https://ophysics.com/l15.html
2. Set the diffraction grating lines to 4000 lines per mm
3. Set the distance b/w the grating and the screen to 6 cm.

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Calculation

$d\sin\theta = n\lambda$

① $d\sin\theta = n\lambda$

$\lambda = \frac{d\sin\theta}{n} = \frac{0.1 \times \sin(0.2054)}{400}$

$\lambda = 0.1 \times 0.2054$

$= 0.5125$

$\lambda = 512 \times 10^{-4}$

$\lambda = 512nm$

$d\sin\theta = n\lambda$

$\lambda = \frac{d\sin\theta}{n}$

$\lambda = \frac{0.1 \times \sin(0.363)}{400 \times 2}$

$= \frac{0.0355}{800}$

$= 0.4439$

$= 44.4 \times 10^{7}$

$\lambda = 443nm$

$d\sin\theta = n\lambda$

$\lambda = \frac{d\sin\theta}{n}$

$= \frac{0.1 \times \sin(0.36)}{400}$

$= \frac{0.0532}{12000}$

$= 0.441 cm$

444×10^{-7}

$\lambda = 444nm$

$\lambda_{mean} = 512 + 443 + 444 = 466nm$

Result ;-

The laser ~~light~~ wavelength λ is 466nm.

4. choose the wavelength of the laser
5. confirm the grating is in place and all setting are correct.
6. Measure the distance from the principal maximum to various diffraction orders (1st, 2nd and etc.)
7. Use the diffraction eqn to calculate the wavelength or confirm it.

Theory:

A diffraction grating consists of closely spaced lines that cause light to diffract, or spread out, into various angles. When monochromatic light (such as laser) passes through or reflects off the grating

The angles at which these maximum occur are governed by grating eqn: $d\sin\theta = n\lambda$ & $d = \frac{1}{N}$

By measuring the angles at which maxima occurs for different diffraction orders and knowing the setup geometry, the wavelength of the incident light can be determined. This experiment demonstrates the wave of light and allows precise measurement of wavelengths, such as that of a laser by analyzing the diffraction