WAVELENGTH OF LASER LIGHT USING DIFFRACTION GRATING

Presented by
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WAVELENGTH OF LASER LIGHT USING DIFFRACTION GRATING

OBJECTIVE, AIM & APPARATUS

Objectives

- To determine the concept of diffraction
- To determine the wavelength of the given Laser source
- To learn about the characteristics of Laser
- To study the various types of Laser

Aim

- To determine the wavelength of laser light using diffraction grating.
- Apparatus required
- Optical bench, semiconductor laser, Diffraction grating and screen or scale arrangement.

The laser is mounted on its saddle on the optical bench.

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EXPERIMENTAL PROCEDURE

- The grating is mounted on an upright next to laser.
- The screen is placed next to the grating as shown in figure.
- The laser is switched on.
- The relative orientation of laser with respect to grating is adjusted such that spectral spots are observed on the screen.
- The screen is moved towards and away from the grating till at least three (for 200 lines/mm) spots are clearly seen on the screen on either side of the central spot.
- The central maximum and other maxima corresponding to different orders of the spectrum on either side of the central maximum are identified.
- A scale is adjusted in such a way that the central spot coincides with the zero in the scale.
- If the diffraction grating is not labelled with the line spacing it will be necessary to measure the line separation using a microscope.
- Be careful to convert any stated line spacing given in lines/mm to a line separation in meter or mm.

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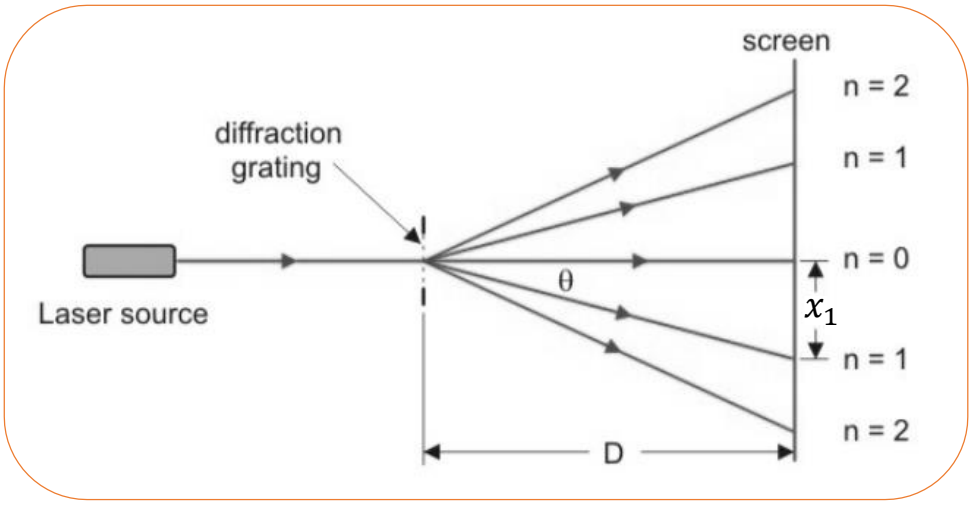

- Now the distances $(x_1, x_2, x_3, ---\ -x_n)$ of the spots corresponding to 1st order, 2nd order etc. on the either side of central maxima are noted.
- On the screen, measure the distance between corresponding dots i.e. L1 and R1 (According to diagram)
- The distances between the grating and the screen (D) is measured.
- The readings are tabulated.
- The experiment is repeated for at least three values of D (20cm,30cm,40cm).

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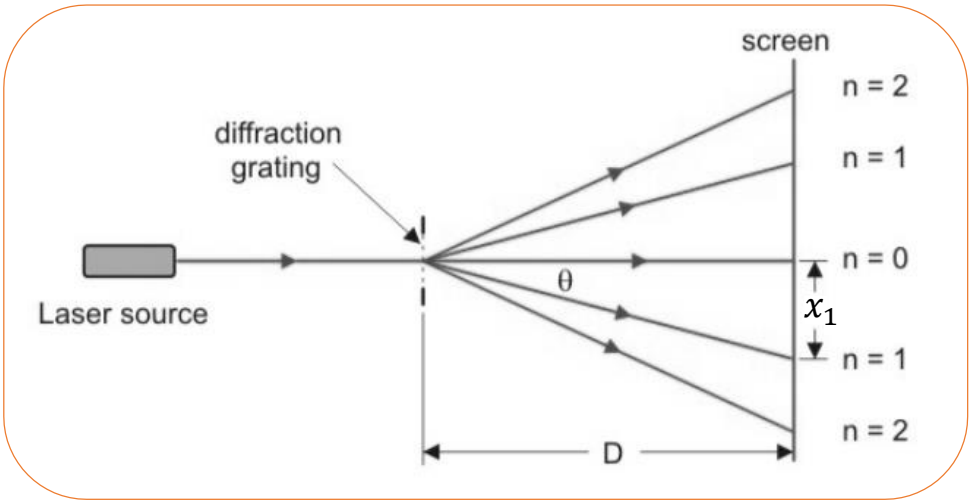
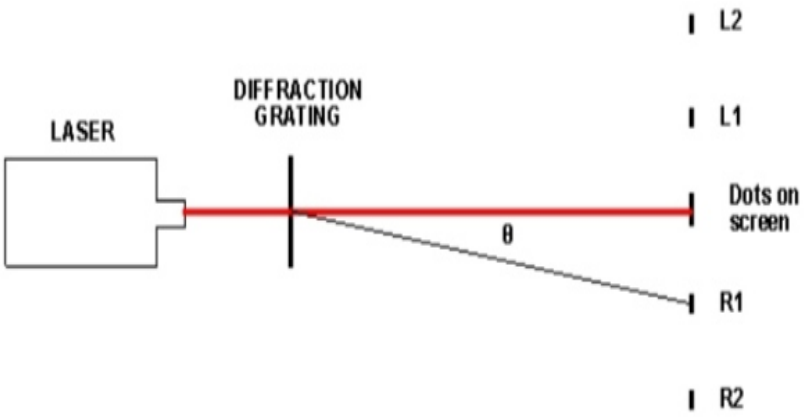
- The value of x_n $(x_1, x_2, x_3, ---- -x_n)$ is calculated for each case and calculated $\boldsymbol{\theta}_n$ $(\boldsymbol{\theta}_1, \boldsymbol{\theta}_2, \boldsymbol{\theta}_3, ------ -)$ using the formula $\boldsymbol{\theta} = \tan^{-1}\frac{x_n}{D} = \tan^{-1}\frac{L1R1}{2D}$ (According to diagram)
- Using this formula calculated sin $\boldsymbol{\theta}$





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EXPERIMENTAL OBSERVATION

No of obs	Order no	Distance of n th order maxima from the principal maxima (m)			Distance of screen from grating (D) m	$\theta_n = tan^{-1}(\frac{x_n l + x_n r}{2})$	$\sin\theta_n$	$(\lambda) = \frac{\sin\theta}{nN}$ m
		Left side ($x_n l$)	Left side ($x_n r$)	Average $\frac{(x_n l + x_n r)}{2}$				
1.	1. 2. 3.							
2.	1. 2. 3.							
3.	1. 2. 3.							

CALCULATION & RESULT

CALCULATION(S)

Distance of the spot from the central maxima (x_n) = ---------- m

Perpendicular distance between grating and the screen (D) --------- m

Number of lines per metre in the grating (N) = ---------- lines/m

Angle of diffraction ($\boldsymbol{\theta}$) = $tan^{-1}(\frac{x_n}{D})$ = tan^{-1} ($\frac{L1R1}{2D}$) (According to diagram)

Wavelength of laser light ($\boldsymbol{\lambda}$) = $\frac{\sin \boldsymbol{\theta}}{nN}$ = ---------- m, where n is the order of spectrum

RESULT

Wavelength of laser light, $\boldsymbol{\lambda}$ = ---------- m

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CALCULATION & RESULT

At the end of the experiment, the students would be able:

- To determine the wavelength of the given laser source.
- To understand the importance of laser beam compared to ordinary light.
- To provide the use of Laser for different applications.
- To understand the application of lasers in engineering and medical fields.
- To get depth in knowledge about the Lasers and its applications in various fields.