
Experiment No.:- 01 **Date:-** 22/6/2021

STUDY OF FRAUNHOFER DIFFRACTION DUE TO A SINGLE SLIT USING LASER AS A LIGHT SOURCE

(Module 1)

DJ19FEC202.1: Apply the foundations of Optics and Photonics in development of modern communication technology.

AIM: - The aim of the experiment is to study Franunhofer diffraction occurring
i) At a single slit and
ii) To determine the width of the slit.

APPARATUS: - A 5mW He-Ne LASER, a screen, a meter scale.

THEORY: - Under normal circumstances, light passing through an opening produces a bright image of the opening on screen held opposite to the opening. In the same way, light passing through a single slit produces a bright linear image of the slit. However, when the width of the slit is reduced to a small value, there arise a few more bright and dark bands on either side of the central bright image.

The pattern on the screen is called the diffraction pattern. The number of bands and their distances from the central maximum depend on the width of the slit. By measuring the distance of different order minima from the centre of the central bright image, the slit width can be determined.

A dark band occur whenever,

$$d \sin \theta = m \lambda$$

Where, d= width of the slit
λ= wavelength of light
θ= angle of diffraction
m= order of minima from the center of the central bright image

FORMULA:-

The width of the single slit is given by,

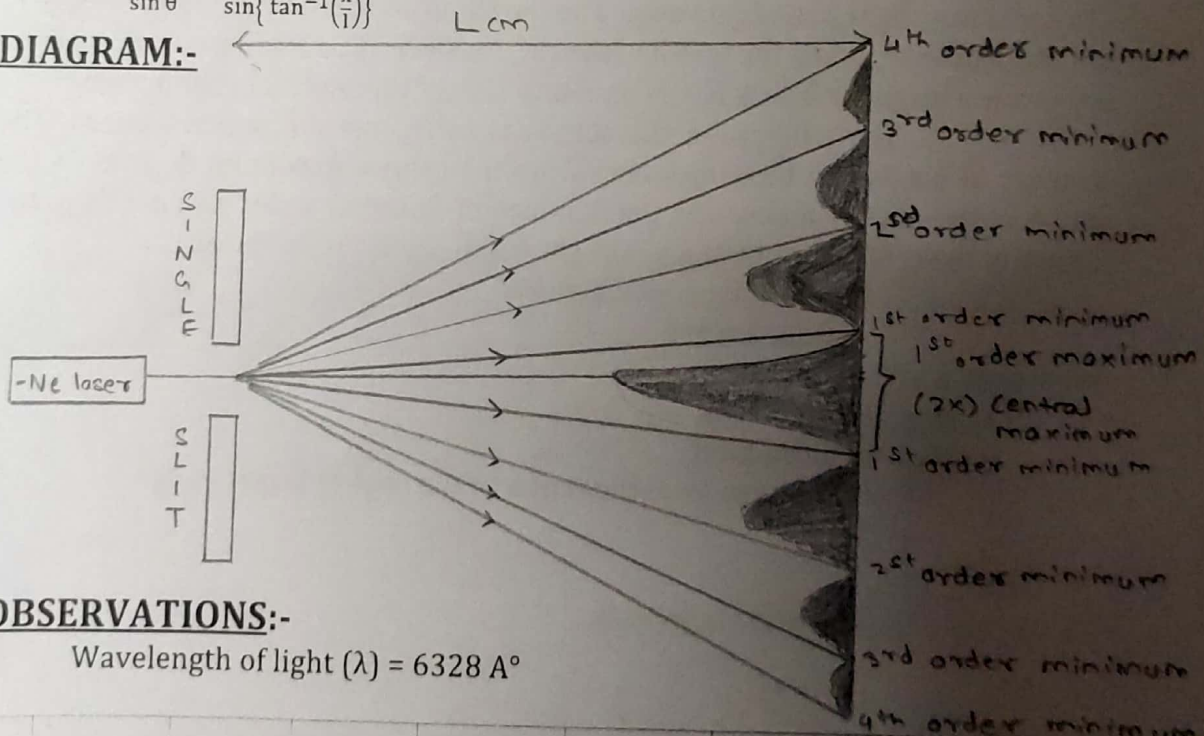
$$d=\frac{m\lambda}{\sin \theta}$$

where, λ= wavelength of light
θ= angle of diffraction
m= order of minima

PROCEDURE:-

1. The He-Ne LASER is mounted on it saddle on the optical bench.
2. A single slit is mounted next to the LASER.
3. The laser is switched on and the position of the slit is adjusted such that the laser beam passes through the slit and falls on a screen opposite to it.
4. The slit is slowly closed with the help of its rotational screw .As the slit width reduces a bright central maximum with a large number of maxima of diminishing intensity on its either side are observed on the screen.
5. The centers of first, second and third order minima are marked on either side of the central maximum. The separations '2x' between the centers of two first order minima, second minima and third order minima are measured respectively, and noted in the observation table.
6. The distance of the screen from the slit is measured by using a measuring tape.
   l= distance between the screen and slit
7. The slit width 'd' is computed from the formula,
8. $d=\frac{m\lambda}{\sin\theta} = \frac{m\lambda}{\sin\left\{\tan^{-1}\left(\frac{x}{l}\right)\right\}}$

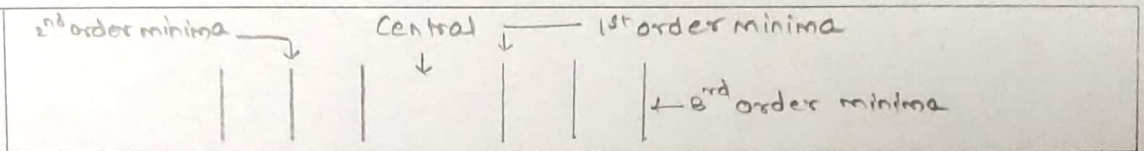
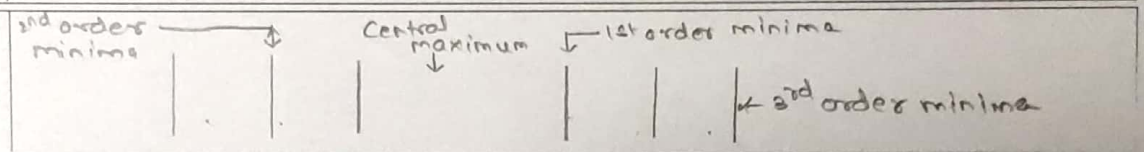
DIAGRAM:-



OBSERVATIONS:-

Wavelength of light (λ) = 6328 A°

SET	'l'(cm)	Order No.(m)	'x'(cm)	'2x'(cm)	$\tan\theta=\frac{x}{l}$	$\sin\theta$	$d=\frac{m\lambda}{\sin\theta}$ (mm)	Mean 'd' (cm)
I	160	1	0.4	0.8	0.0025	0.0025	0.253	
	160	2	0.75	1.50	0.0047	0.0047	0.269	
	160	3	1.1	2.2	0.0069	0.0069	0.279	
II	220	1	0.475	0.95	0.0022	0.0022	0.288	0.0286
	220	2	1	2	0.0041	0.0041	0.309	
	220	3	1.3	2.6	0.0059	0.0059	0.323	

$l = 160$cm	
$l = 220$cm	

RESULT:-

The mean slit width is = 0.0286 cm.

COMMENTS:-

1. What is the fundamental criteria for diffraction?

The slit width has to be comparable or less than the wavelength of light for prominent diffraction patterns.

2. What will be the effect on the fringe pattern if the slit width is changed?

If the slit width is increased, the fringe pattern gets narrower and if slit width is decreased, fringe pattern becomes wider. This is because fringe width is inversely proportional to slit width.

D.J.S.C.E. (Physics)		
Journal		
Knowledge	3	
Documentation	3	
Punctuality	3	
Virtual Lab (Performance & Documentation)	6	
Total	15	

Date	Signature of the faculty