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B.Tech. I / II Sem

EXPERIMENT: 5 -SLIT DIFFRACTION

OBJECT:

To determine the Grating element of given 5 slits grating using He-Ne laser

APPARATUS USED:

Optical bench with suitable accessories, 5-slit unit, He-Ne laser source etc.

THEORY:

In physics, a **laser** is a device that emits light through a specific mechanism for which the term **laser** is an acronym. **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

A **helium-neon laser**, generally called **He-Ne laser**, is a type of small gas laser. This lasers have many industrial and scientific uses, and are often used in laboratory demonstrations of optics. The gain medium of the laser, as suggested by its name, is a mixture of helium and neon gases, in a 5:1 to 20:1 ratio, contained at low pressure

This experiment is based on the diffraction of light. The very heart of the explanation of all diffraction phenomena is interference. When two waves combine, their displacements add, causing either a lesser or greater total displacement depending on the phase difference between the two waves. The bright bands observed on the screen happen when the light has interfered constructively—where a crest of a wave meets a crest from another wave. The dark regions show destructive interference—a crest meets a trough.

Constructive interference to give bright band occurs when

$$\frac{n\lambda}{d} = \frac{x}{L} \quad \Leftrightarrow \quad n\lambda = \frac{xd}{L},$$

Where,
λ is the wavelength of the light,
d is the separation of the slits,
n is the order of maxima observed (for maxima, n=1),
x is the fringe distance, and
L is the distance from the slits to the screen.

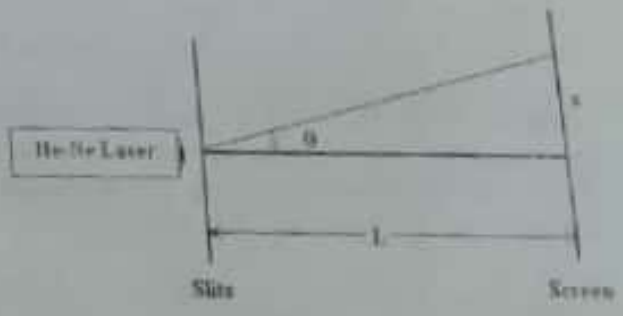

Fig 1. Laser Diffraction Experiment

If λ and L are known and x is observed, then a can be easily calculated.

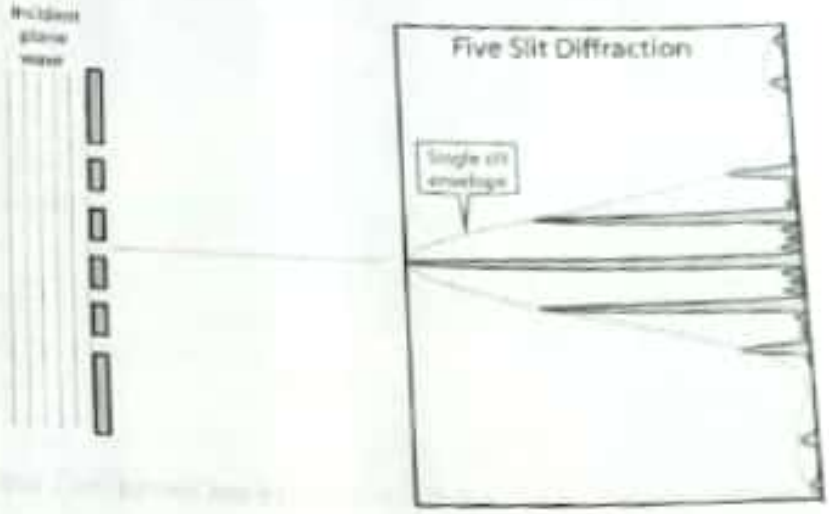

Fig: 2 Diffraction patterns for 5-slits

Fig. 3 Experimental setup for grating element

PROCEDURE:

1. Make sure that the incident LASER beam and the screen are both along one, single horizontal line.
2. Set the screen behind the slit so close as to get the sharpest diffracted image. We get four bright Red vertical lines in the image for a given set of slits.
3. Fix the screen at a point to 30cm away from the slit (L cm).
4. Set the cross wire on the image of first slit by using the screw gauge (connected at the bottom of screen holder) which controls their movement. Note this reading of screw gauge.
5. Measure the screw gauge reading similarly for all rest of the lines in the image.
6. Measure the separation between all the two consecutive lines and find out an average separation termed as "x" cm.

7. Using this value of average separation "x" and that of wavelength "λ" given for He-Ne LASER, calculate the grating element "d" cm
8. Increase the distance of screen from the slit by 10cm, and repeat the procedure step-4 to -7.
9. Average out the two "d" values.

OBSERVATIONS:

Wavelength of He-Ne laser = ...6328 Å...

=..... cm

Least count of screw gauge circular scale= ..... cm

TABLE: For measuring Fringe width x.

Distance of screen from slits D (cm)	Fringes	Position of fringes on screen			Fringe width x (cm)	Mean value of x (cm)
		Main scale (cm)	circular scale (cm)	Total (cm)		
30 cm	1.			A=.....	A-B=..... B-C=..... C-D=..... D-E=.....	
	2.			B=.....		
	3.			C=.....		
	4.			D=.....		
	5.			E=.....		
40 cm	1.			A=.....	A-B=..... B-C=..... C-D=..... D-E=.....	
	2.			B=.....		
	3.			C=.....		
	4.			D=.....		
	5.			E=.....		

CALCULATIONS:

Grating element d,

$d = n\lambda D/x$ [n=1]

=.....cm

Average d=.....cm

RESULT:

The Grating element of given 5 slits grating is ..... cm

PRECAUTIONS AND SOURCE OF ERROR:

i. NEVER LOOK INTO A LASER BEAM
ii. Incident LASER beam, Beam expander, slits and the screen are should be along one, single horizontal line.
iii. Operate the knob of screw gauge carefully.