

# NETAJI SUBHAS UNIVERSITY OF TECHONOLGY



## Group2:

- Athang Suryakant Patil (2023UEC2664)
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- Naitik Pahwa (2023UEC2680)
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- Khushi (2023UEC2684)
- Saksham Pal (2023UEC2685)

Project report on:

Wavelength of He-Ne laser using a  
diffraction grating

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## CERTIFICATE

This is to certify that Athang Suryakant Patel, Mustafa Ahmed, Naitik Pahwa, Aditya Kumar, Chinmay Naryan, Nikhil Arya, Khushi, Saksham Pal of ECE-2 branch have successfully completed their physics project for first semester practical of the year 2023-24.

\_\_\_\_\_  
Professor In-Charge

## ACKNOWLEDGMENT

We would like to thank our professor in-charge and the lab assistants, for their support and guidance in completing our project on the topic *determination of the wavelength of He-Ne laser*. It was a great learning experience and would not have been possible without our constant determination.

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- Laser in military
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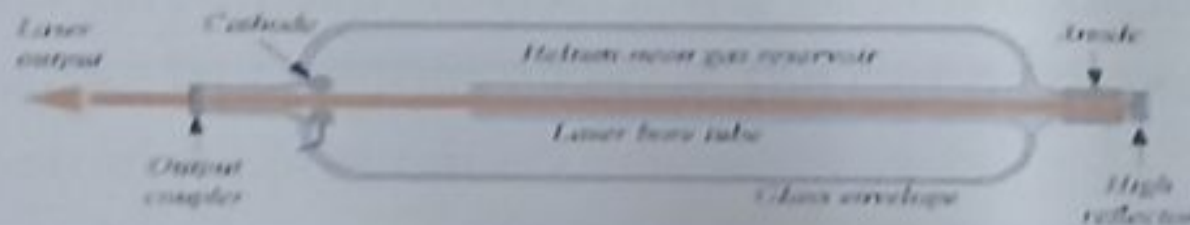


# AIM OF EXPERIMENT

*To find the wavelength of He-Ne laser using a diffraction grating.*

# APPARATUS USED

- He-Ne laser
- Diffraction Grating
- Screen
- Measurement Scale



# THEORY AND FORMULAS

Helium-Neon laser is a type of gas laser in which a mixture of helium and neon gas is used as a gain medium. Helium-Neon laser is also known as He-Ne laser.

A gas laser is a type of laser in which a mixture of gas is used as the active medium or laser medium. Gas lasers are the most widely used lasers.

Gas lasers range from low-power helium-neon lasers to very high-power carbon dioxide lasers. The helium-neon lasers are most used in college laboratories whereas the carbon dioxide lasers are used in industrial applications.

The main advantage of gas lasers (e.g.: He-Ne lasers) over solid state lasers is that they are less prone to damage by overheating so they can be run continuously.



At room temperature, a ruby laser will only emit short bursts of laser light, each laser pulse occurring after a flash of the pumping light. It would be better to have a laser that emits light continuously. Such a laser is called a continuous wave (CW) laser.

The helium-neon laser was the first continuous wave (CW) laser ever constructed. It was built in 1961 by Ali Javan, Bennett, and Herriott at Bell Telephone Laboratories.

Helium-neon lasers are the most widely used gas lasers. These lasers have many industrial and scientific uses and are often used in laboratory demonstrations of optics.

In He-Ne lasers, the optical pumping method is not used instead an electrical pumping method is used.

The helium-neon laser operates at a wavelength of 632.8 nanometers (nm), in the red portion of the visible spectrum.

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

$n$  = the order of the diffracted beam

$d$  = the separation of the lines on the grating

$\theta$  = the angle of maxima

$\lambda$  = the wavelength of light

To work out  $d$  calculate  $1/(\text{lines/m})$

# PROCEDURE

1. Place a diffraction grating in front of laser beam to obtain the diffraction pattern on screen.
2. The central maxima (brightest spot) is due to undeviated rays.
3. Measure distance from screen to grating( $x$ ):
4. Measure the distance of first order ( $N=1$ ) from central spot ( $Y_1$ ) and then  $\sin(\theta_1)$  and then wavelength.
5. Measure the distance of first order ( $N=2$ ) from central spot ( $Y_2$ ) and then  $\sin(\theta_2)$  and then wavelength.
6. Repeat for different values of  $x$ .



# OBSERVATIONS

S.no	Order of Diffraction (n)	Position of the screen from the grating (x cm)	Distance from the Centre (y cm)	$\sin \theta = \frac{y}{\sqrt{x^2 + y^2}}$	$\lambda$ (nm)
1.	1	20	3.8	0.186	622
2.	2	20	8.2	0.379	632
3.	1	26	5.9	0.192	640
4.	2	26	11.1	0.392	654
5.	1	16	3.0	0.184	614
6.	2	16	6.6	0.381	635

# CALCULATIONS AND RESULT

Mean ( $\lambda$ ) =  $\Sigma \lambda / n$  (n=no. Of observations)

= 632.83

Actual wavelength= 632.8

%Error =  $[\{\lambda(\text{actual}) - \lambda(\text{mean})\} / \lambda(\text{actual})] \times 100$

= 0.005%



# PRECAUTIONS AND ERROR

- Do not look directly into the laser beam. It may damage your eyes.
- Do not look at spectacular reflections of laser beam.
- Take care when moving objects in path of the beam of laser.
- Remove all bright mirror like objects from the work area including rings, metal bands and tolls. Beam reflections can be nearly as intense as the original beam.
- The laser should neither be too close or too far from the sources keep a distance of few meters.
- The spread should be obtained on a wide screen.
- The power supply retains potentially harmful voltages for periods after the input power has been ceased. Never open the housing and expose anyone to these voltages.



# USES OF LASER

## ☐ Military

- Weapons
- Radar

## ☐ Telecommunication

- Holograms
- Satellites
- Computer mouse

## ☐ Medical

- Tattoo removal
- Optical and general surgery

# LASER IN MILITARY

- Laser range finders are used to determine the distance to an object.
- The ring laser gyroscope is used for sensing and measuring very small angle of rotation of the moving objects.
- Lasers are used to dispose the energy of a warhead by damaging the missile.
- Lasers is used in LIDAR's to accurately measure the distance to an object.





# LASER IN COMMUNICATION

- Laser light is used in underwater communication networks.
- Lasers are used in space communication, radars and satellites.
- Laser light is used in optical fiber communications to send information over large distance with low loss.





