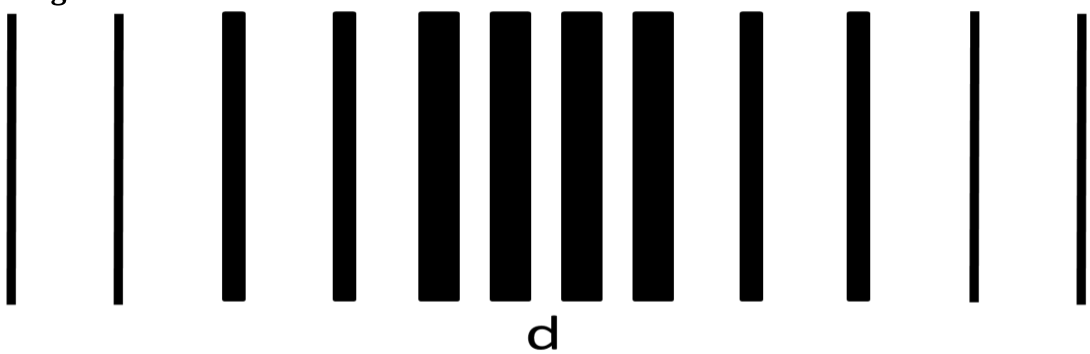
Experiment No. 3
Diameter of cylindrical obstacle

Aim and Objectives: To determine thickness of given obstacle using diffraction.

Apparatus: Cylindrical obstacle, optical bench with necessary accessories, Sodium vapour lamp

Diagram:



Outcome: To explain use of diffraction in thickness measurement.

Theoretical background:

Diffraction: The bending of light around sharp obstacle and spreading in the geometrical shadow is called diffraction. Italian scientist Francesco Maria Grimaldi was the first to record accurate observation of the phenomenon of diffraction. The intensity distribution obtained on screen is known as diffraction pattern.

The diffraction is due to failure of light beam to travel in a straight line when the beam just passes over the sharp edge and it can only be explained by the wave nature of light.

When slit width is large compared to wavelength of light, the waves do not bend around the edges and diffraction is not seen. For smaller slit width, diffraction becomes noticeable. When the slit width is comparable to the incident wavelength, waves spread over all the surface behind the slit and it seems to act as independent source of light. Interpretation for diffraction was given by Fresnel. According to Fresnel's theory, diffraction pattern is obtained due to mutual interference of secondary wavelets originating from various points of wavefront which are not blocked off by the obstacle.

When very fine beam of light is incident on a sharp obstacle, it is diffracted. Angle of diffraction depends on wavelength of light and size of obstacle. There are two types of diffraction.

1. Fresnel's diffraction: Source and screen are at finite distance from obstacle.
2. Frauhnofer's diffraction: Source and screen are at infinite distance from obstacle.

Experimentation:

Set cylindrical obstacle on a prism stand and adjust the height of accessories (slit, obstacle stand and eyepiece stand) such that all three are in the same line (i..e light coming from the slit can be seen through eyepiece). Fine beam of monochromatic light is incident on obstacle and it is diffracted. Diffraction pattern can be seen through eyepiece. It consists of alternate dark and bright fringes.

First measure the distance D between the slit and eyepiece. Find fringe width (distance between two successive dark fringes) of diffraction pattern using micrometer attached to eyepiece.

Observations:

1 The least count of micrometer:: **L=M/S**

Where, Smallest division on main scale (M) =

Total number of division on circular scale (S) = cm

Least count=(L)=M/S= cm

2 Reading for D:

Observed distance on the bench between the slit and eyepiece D_{1}=..........

Actual distance on the bench between the plane of the slit and eyepiece D =

Bench error = D ~ D_1

Observation Table:

Sr. No.	**Order of Fringes**	**Main scale Reading (A)**	**Coinciding division on circular scale (S)**	**Total reading C=A+(Sx L.C.)**	**Fringe width X**	**Mean Fringe width X**
1						
2						
3						
4						
5						
6						

Formula: Wavelength λ = Xd/D

Where d= Width of thickness of cylindrical obstacle to be determined

λ = Wavelength of given sodium (monochromatic) source =5896A^0

D= Distance between the slit and eyepiece

X=Fringe width

Calculations:

Result and discussion:

The thickness of given cylindrical obstacle is

Conclusion:

Questions:

1. What is the principle used in this experiment?
2. What type of diffraction used here? Justify your answer.
3. What is the nature of pattern that is seen through eyepiece?
4. What is bench error? How will you measure it?