EXP.NO. (1)

Laser Application for Measuring Multi Slit

The aim of experiment

1) Observe Fraunhofer diffraction and interference from multiple-slit (a diffraction grating)
2) Calculate the slit spacing of a diffraction grating.

Apparatus:-

Helium-Neon laser, Multi slit (grating), Screen, Ruler.

Theory:-

Diffraction occurs when a portion of a wave passes through a slit. Interference occurs when two or more coherent waves overlap. (Coherent means that the waves have a fixed phase relationship.) Constructive interference takes place at certain locations where two waves are in phase (for example, both waves have maximum). Destructive interference takes place where two waves are out of phase (for example, one wave has maximum, the other has minimum). In the case of a single-slit, diffraction is the only effect present. In the case of two or more slits, two effects are present: a) diffraction from each individual slit; b) if the incident light is coherent and the diffraction patterns of each slit overlap, then interference takes place in the region of the overlap, (i.e., inside the diffraction envelope). The simplest diffraction and interference patterns involve plane waves (collimated or parallel light beams). Diffraction patterns associated with plane waves are called Fraunhofer patterns, named after the German scientist who first explained the effect. In this experiment, we will use a laser as our light source. A laser produces collimated and coherent light beams at one wavelength.

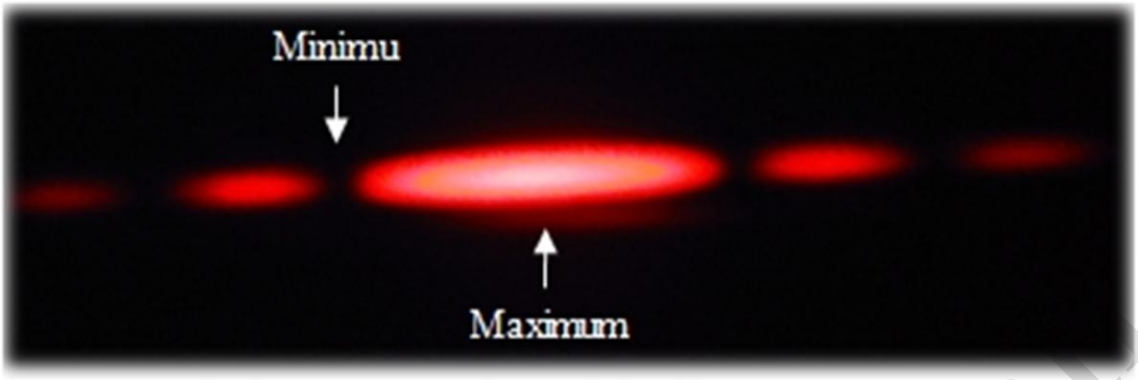

Figure 1 : the bright spots are the maxima. The dark spots between them are the minima

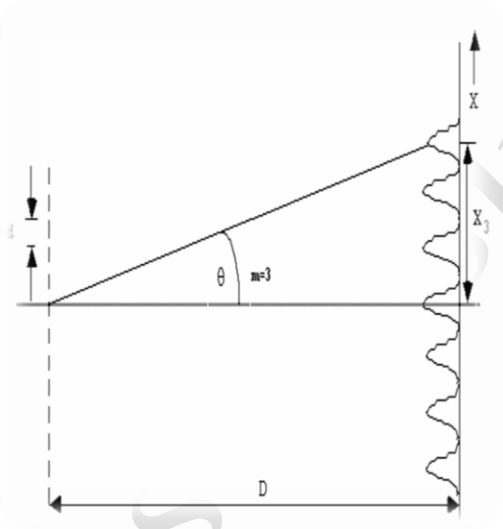

Figure 2: Intensity distribution of a diffraction grating

A multi-slit grating is commonly referred to as a diffraction grating, a more appropriate name for it is an interference grating. The phenomenon that is observed is interference and not as its name suggests diffraction. The condition here for interference maximum is the same as for double-slits, but the pattern may be very different because *d* (the slit spacing) for gratings is very small.

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

EXPERIMENTAL PROCEDURE

The wavelength (λ) of He-Ne laser used in this experiment is(632.8) nm
a) Place the grating in the laser beam (close to the screen, not far away).
b) Measure the distance from the plane of the grating to the screen (D) and record it in an Excel spreadsheet.
c) Record the labeled ruling density (grooves/mm) in your Excel spreadsheet.
d) Tape a piece of paper across the screen. Mark carefully the positions of the principal maximum and the interference maxima. Remove the paper from the screen and attach it to your lab report.
e) Measure the distance of each interference maximum from the principal maximum (X_n) and record them in your Excel spreadsheet. 1nd fringe (X_1), 2nd fringe (X_2) ……as follows:

n (number of diffraction)	X
n_1	X_1
n_2	X_2
n_3	X_3

And plot a graph between number of diffraction (n) and X_n
f) Apply d = D. slop (n/x). λ
Where d is the width of slit

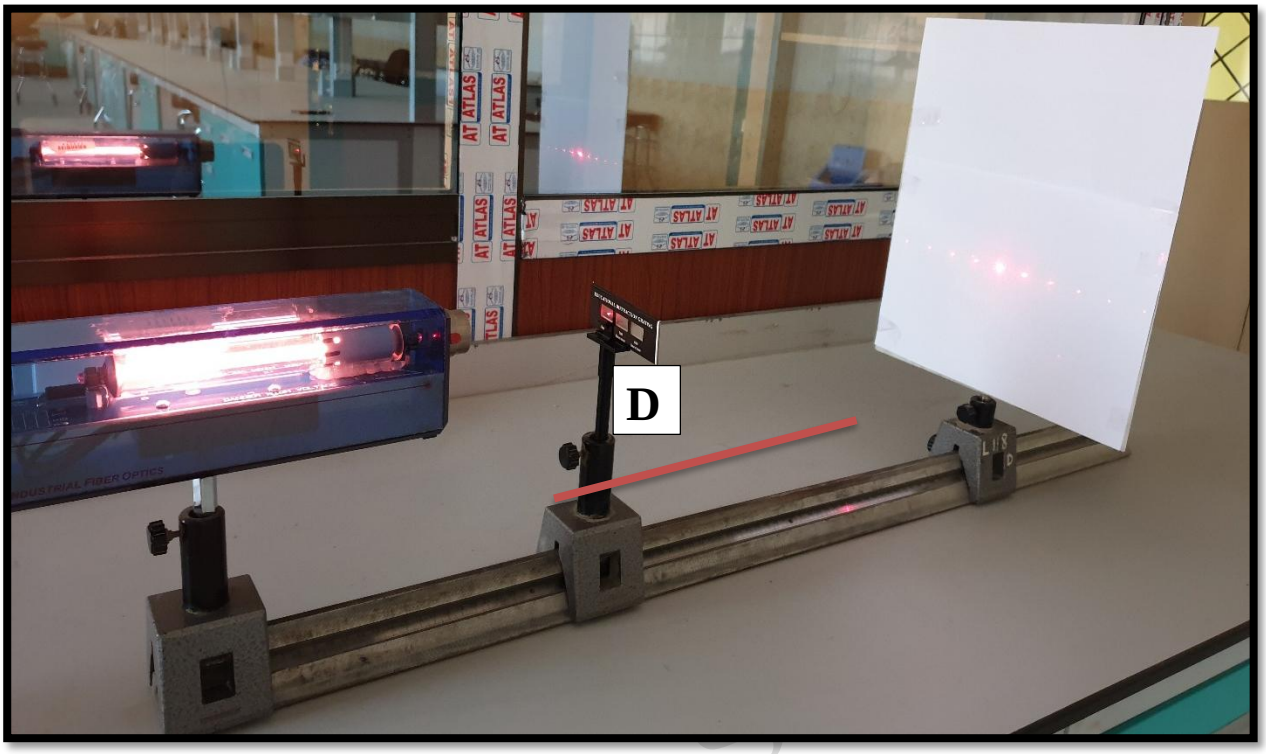

Figure 3: Set up the experimental

CAUTION: Even though the lasers used in the laboratory are of low power and do not require special eyewear, serious injury may still occur. The following precautions MUST be observed at all times:

- **keep the laser turned off when not in use;**
- **do not move the laser around when it is on;**
- **do not mount the laser at eye level;**
- **do not look head on at the beam or at its reflection from a mirror or other shiny surfaces;**
- **Never aim a laser at another person.**