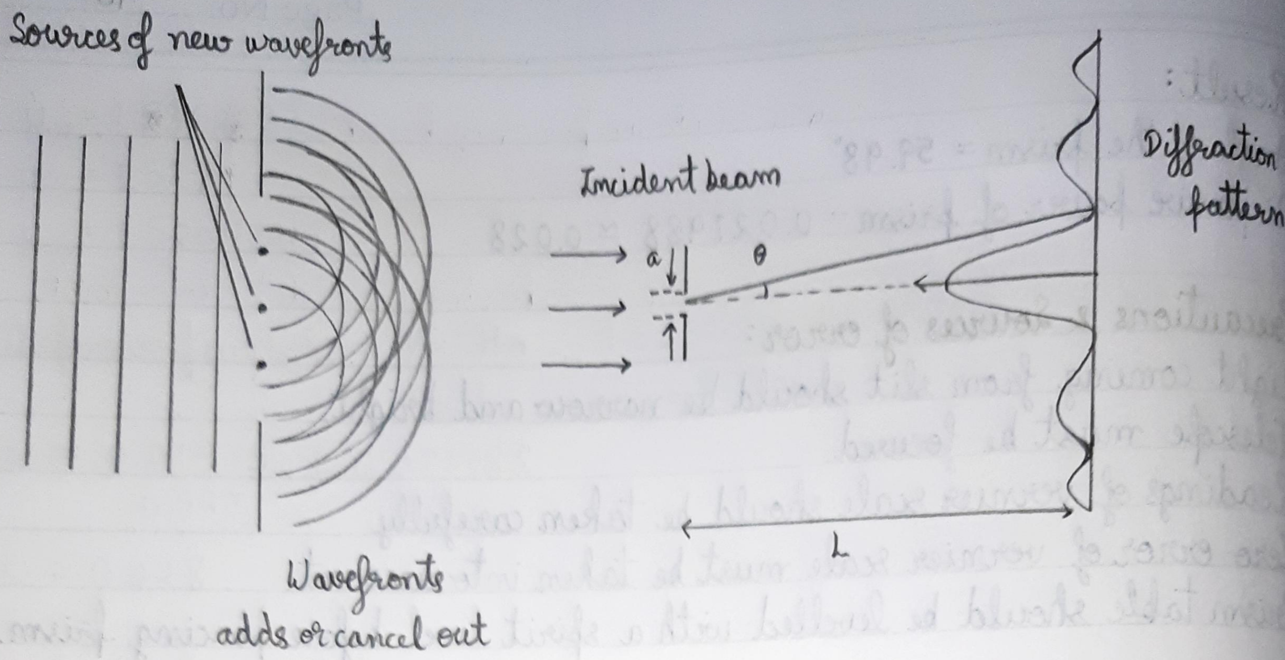

Observations :

To determine no. of lines per mm

Order (n)	Left Readings		Right Readings		Difference readings		Mean (θ)
	Ver I	Ver II	Ver I	Ver II	2θ Ver I	2θ Ver II	
n = 1	340.5	160.5	19	199	38.5	38.5	19.25
n = 2	318.5	138.5	40.5	220.5	82	82	41

To determine wavelength of yellow line

Order (n)	Left Readings		Right Readings		Difference readings		Mean (θ)
	Ver I	Ver II	Ver I	Ver II	2θ Ver I	2θ Ver II	
n = 1	339.5	159.5	20	200	40.5	40.5	20.25
n = 2	316	136	43.5	223.5	87.5	87.5	43.75

Experiment 4.

Aim:

1. To determine the no. of lines per mm of the grating using the green line of the mercury spectrum.
2. To calculate the wavelength of the yellow lines of mercury spectrum by normal incidence method.

Apparatus:

Spectrometer, diffraction grating element and mercury vapor lamp.

Theory:

When a wave strikes an obstacles, the light ray bends at the corners & edges of it, which causes the spreading of light waves into the geometrical shadow of the obstacle. This phenomenon is termed as diffraction.

Single slit diffraction:

When waves pass through a gap, which is about as wide as the wavelength they spread out into the region beyond the gap. Huygens considered each point along a wavefront to be the source of a secondary disturbance that forms a semi-circular wavelet. Diffraction is due to the superposition of such secondary wave-lets. The secondary wavelets spreads out & overlap each other interfering with each other to form a pattern of maximum & minimum intensity. The pattern formed on a screen consists of a broad central band of light with dark bands on either sides. The dark bonds are caused when the light from the top half of the slit destructively interfere with the light from the bottom half.

Calculations :

To determine no. of lines per mm

Wavelength of green light, $\lambda_g = 546.1\ nm$

for $n=1$, Mean $\theta = 19.25°$

$$N = \frac{\sin 19.25°}{1 \times 546.1} \times 10^9 = 6.03 \times 10^2\ mm^{-1}$$

for $n=2$, Mean $\theta = 41°$

$$N = \frac{\sin 41°}{2 \times 546.1} \times 10^9 = 6.02 \times 10^2\ mm^{-1}$$

$$\text{Mean } N = \frac{6.03 \times 10^2 + 6.02 \times 10^2}{2} \simeq 6.02 \times 10^2\ mm^{-1}$$

To determine wavelength of yellow line

for $n=1$, Mean $\theta = 20.25°$

$$\lambda = \frac{\sin 20.25°}{1 \times 6.02 \times 10^5} \simeq 574.9\ nm$$

for $n=2$, Mean $\theta = 43.75°$

$$\lambda = \frac{\sin 43.75°}{2 \times 6.02 \times 10^5} \simeq 573.9\ nm$$

$$\text{Mean } \lambda = \frac{574.9 + 573.9}{2} = 574.4\ nm$$

Standard value $= 589\ nm$

$$\text{Percentage error} = \frac{589 - 574.4}{589} \times 100 \simeq 2.48\%$$

Formula used:

$\sin\theta = nN\lambda$

where, n is order of spectrum

N is no. of lines per unit length of grating

λ is wavelength of light

θ is diffraction angle.

Procedure:

1. Set the telescope by focusing on distant object.
2. Turn the telescope to obtain the image of the slit
3. Turn the telescope to both sides & note the readings for green lines.
4. Calculate no. of lines per unit length of the grating
5. Move telescope to make cross wire coincide with yellow line of spectrum.
6. Note the readings from both sides of telescope.
7. Calculate the diffraction angle.
8. Finally, calculate & compare the wavelength of yellow colour.

Results:

No. of lines per unit length of grating $= 6.02 \times 10^5 \ m^{-1} = 6.02 \times 10^2 \ mm^{-1}$

Wavelength of yellow colour light = 574.4 nm (observed value)

Percentage error $\simeq$ 2.48%

Precautions and Sources of errors:

1. Light coming from slit should be narrow & bright.
2. Telescope must be focused.
3. Readings of vernier scale should be taken carefully.