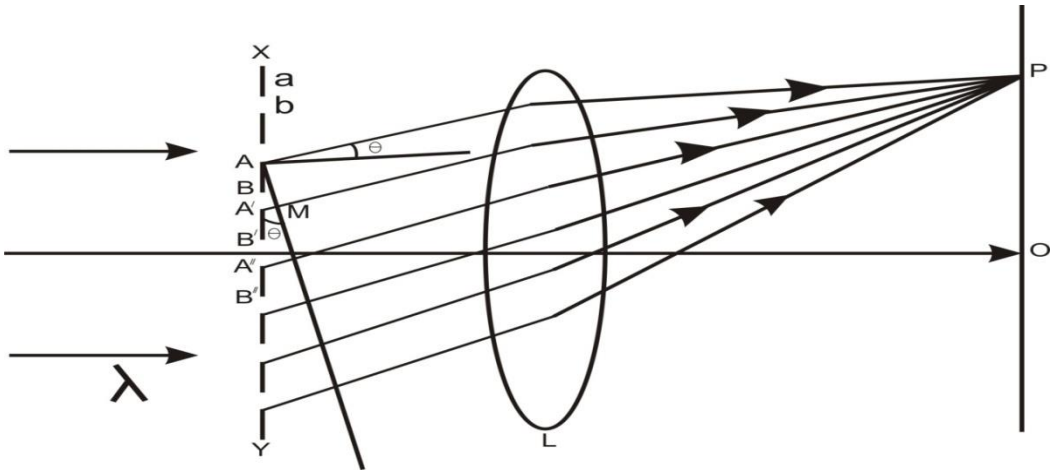
# Experiment No.4
# Diffraction grating using mercury vapor lamp

**Aim and Objectives:** To determine wavelength of light from mercury vapour lamp using diffraction grating.

**Apparatus:** A spectrometer, a spirit level, a mercury vapour lamp, diffraction grating etc.

**Diagram:**




**Outcome:** To explain use of grating in determination of wavelength.

**Theoretical Background:**

Diffraction - Bending of light round the obstacle and spreading in a geometrical shadow is called diffraction.

Diffraction grating—A plane diffraction grating is a set of a large number of parallel equidistant slits. It is prepared by ruling equidistant parallel lines on a glass surface with a diamond point the no of grating lines are about 15000per inch.

Consider the plane transmission grating with N number of slits. Parallel beam of monochromatic light of wavelength λ is normally incident on grating. According to Huygens' principle, every point in the slit becomes secondary source and gives secondary wavelets that interfere producing intensity maxima and minima as shown in figure.

The condition for bright is given by,

$(a+b)\sin\theta = n\lambda$

Using this equation, wavelength of spectral line can be determined using diffraction grating and spectrometer. Wavelength range of visible light is $4000A^0$ to $7000A^0$.

**Principle:** Angle of diffraction is proportional to wavelength. Hence different wavelengths are diffracted at different angles and it gives separation.

**Experimentation:**

Setting - Adjust the position of the eyepiece of the telescope so that cross wires are clearly visible. Focus the telescope on a distant object and set it for parallel rays. Level the spectrometer with leveling screws and prism table with the help of a spirit level.

The collimator and telescope of spectrometer are adjusted for parallel rays. Fine beam of white light is normally incident on grating that gives diffraction. Diffracted rays are made incident on telescope which can be rotated about the axis of spectrometer. Different wavelengths are diffracted at different angles and separated and it gives spectrum. First Telescope is adjusted in line with collimator to obtain direct image (central maximum) of the slit at the crosswire in the field of view of telescope. Then position of telescope is adjusted on first order principal maximum for violet colour on one side of central maximum and angle θ between the two positions of telescope is recorded on circular scale. Similarly angle θ is measured for different colours. Using the equation,

$(a+b)\sin\theta = \lambda$ Wavelength for different colours can be calculated.

**Observations:**

1) Least count of spectrometer =
   i)Smallest division on main scale (M)=
   ii)Total divisions on venier scale (V)=
   Least count=L= M/V
2) The number of lines /inch on the grating N=15000
   Grating element = a+b=2.54/N=2.54/15000 cm

Direct reading to telescope (A )=

**OBSERVATION TABLE:**

| **Order of spectrum** | **Spectral colour** | **Telescope reading for** | | | **θ=A~B** | **sinθ** |
|---|---|---|---|---|---|---|
| | | **Main scale** | **Circular scale** | **Total reading ( B )** | | |
| 1st order | | | | | | |

**Formula:** $(a+b)\ \sin\theta = n\lambda$

Where n= order of spectrum

$\lambda$ = wavelength to be determined

**Calculations:**

**Result and discussion:**

**1)** Wavelength of violet light
**2)** Wavelength of green light
**3)** Wavelength of yellow -1light
**4)** Wavelength of yellow -2light

**Conclusion:**

**Questions:**

1. What is diffraction grating? How it is constructed?
2. What is difference between prism spectrum and grating spectrum?
3. What is grating element? How it is related to number of slits on diffraction grating?
4. Explain whole radiation spectrum.
5. What is the principle used in this experiment?