Experiment 6:

To determine the wavelength of laser light using Michelson interferometer.

Equipment Required: A Michelson interferometer, He-Ne Laser, collimating lens, Screen, magnifying lens.

Learning objectives:

- To determine the wavelength of monochromatic light (He-Ne Laser).
- To study the phenomena of interference of light.

Theory :

The interferometer is adjusted to obtain circular fringes in the field of view of the telescope. the mirror M1 and M2 are equidistant from the glass plate G1 , the field of view will be perfectly dark. The position of the mirror M1 is adjusted till a particular bright fringe appears in the field of view of the telescope with its centre coincide with the cross-wire. When the mirror M1 is moved backward or forward , each fringe in the focal plane of the telescope is displaced parallel to half. When the mirror M1 is moved through a distance $\lambda/2$, the path difference changes by λ and the position of a particular bright fringe is taken by the next bright fringe. If n is the number of fringes that more across the field of view when the mirror is displaced through a distance L then ..

$n(\lambda/2) = L$ wavelength

$\lambda = (2L/n)$

Diagram:

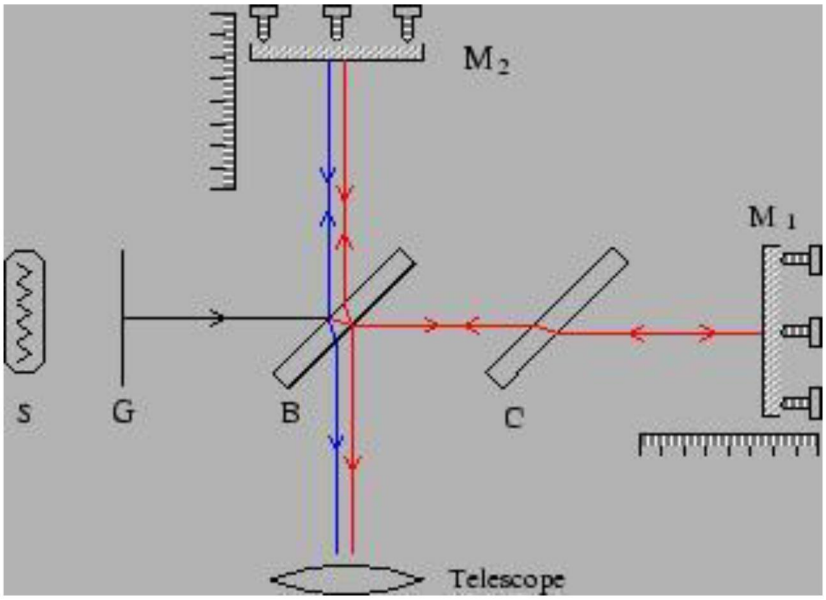

Fig.6.Ray diagram of Michelson Interferometer to measuring wavelength of He-Ne LASER light.

Outline of the procedure:

1. First put the interferometer on a rigid table and level the instrument with three leveling screws provided at the base.
2. Put the Helium-Neon laser, about 50 to 60 cm away from the instrument such that its beam passes through the pin hole fitted in front of the instrument. Make sure that the laser beam falls at the middle of the Mirrors M1 and M2 after getting split from beam splitter plate G1.
3. The beam after the reflections will make four spots on the wall or on a screen. One pair is formed due to partial reflections at the unsilvered surface of G1 and reflections at M1 and M2 respectively. While the other pair is formed due to partial reflections at M1 and M2 respectively. Out of these one pair is brighter than the other.
4. Now mirrors M1 and M2 are tilted carefully such that the two brighter images coincide.
5. Now the instrument is aligned and the fringes are formed on the wall or screen.
6. The mirror M2 is kept fixed and the mirror M1 is moved with the help of the fine movement screw and the number of fringes that cross the field of view is counted.

Scope of the results: The student will be able to find the wavelength of He-Ne laser with the help of interference phenomena and will come to know about the role of path difference in interference of light.

Observations:

Least reading on the main (linear scale) = …… mm = …… cm Least count of rough micrometer screw (R.M.S.) = ……...mm = …… cm Least count of fine micrometer screw (F.M.S.)= …… .....mm=……...…….…… cm

S.No.	No. of fringes shifted	Position of mirror M_1				
1	0	Main scale reading (cm)	R.M.S. reading (cm)	F.M.S. reading (cm)	Total cm	Difference for100 fringes
2	25					
3	50					
4	75					
5	100					
6	125					
7	150					
8	175					
9	200					
10	225					

Mean difference for 100 fringes L= …….cm

Wavelength of light $\lambda = (2l/n)$ = ……cm = …… A^o

Parameter and Plots:

Take any value of n≥20 and note down the value of distance (d) through which the mirror is moved and apply theory of interference of light to find wavelength of light. [Report data in tabular or systematic manner]

Caution:

1. Do not use the telescope.
2. Do not see directly into the laser beam.
3. Make sure that the distances of mirror M1 and M2 are almost equal from beam splitter G1.
4. Make sure that centre of the circular fringes are properly adjusted.

References:

1. B.Sc. Practical Physics by C. L. Arora S.Chand Publication, 20 th edition(2015).

Weblinks:

http://vlab.amrita.edu/?sub=1&brch=281

Worksheet of the student:

Date of Performance: **Registration number:**

Experiment : **To determine the wavelength of laser light using Michelson interferometer.**

Observations:

Least reading on the main (linear scale) =…… mm =…… cm

Least count of rough micrometer screw (R.M.S.)= ….....mm=……....…… cm

Least count of fine micrometer screw (F.M.S.) = ……..mm=…… cm

S.No.	No. of fringes shifted	Position of mirror M_1				Difference for100 fringes
1	0	M. S. scale reading (cm)	R.M.S. reading (cm)	F.M.S. reading (cm)	Total cm	
2	25					
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4	75					
5	100					
6	125					
7	150					
8	175					
9	200					
10	225					

Mean difference for 100 fringes =……. L=…….cm

Wavelengthoflightλ=(2l/n)=……cm=…… A^o

Learning Outcomes (what I have learnt):

To be filled in by faculty:

S.No.	Parameter	Marks obtained	Max marks
1	Understanding of the student about the procedure/apparatus		20
2	Observations and analysis including learning outcomes		20
3	Completion of experiment , discipline and cleanliness		10