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Experiment-5

Aim:

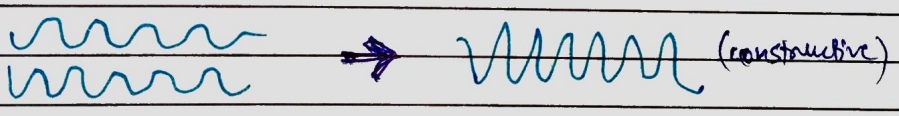
To determine the wavelength of a laser using the Michelson interferometer.

Apparatus:

Laser light source, Michelson Interferometer Kit, optical bench, meter scale.
Online Lab Simulator.

Theory:

Light is a transverse wave. When two waves of same wavelength and amplitude travel through same medium, their amplitudes combine and results in wave of different amplitude. The addition of amplitudes due to superposition of two waves is called interference.



for constructive interference, path difference $= n\lambda$,
$n = 0, 1, 2 \ldots$
for destructive interference, path difference $= \left(n+\frac{1}{2}\right)\lambda$

Teacher's Signature:

No. of fringes	Readings (a)	No. of fringes	Readings (b)	(b-a)
m	0	m+50	0.013	0.013
m+10	0.002	m+60	0.016	0.014
m+20	0.005	m+70	0.018	0.013
m+30	0.008	m+80	0.021	0.013
m+40	0.010	m+90	0.024	0.014

$(b-a)_{mean} = 0.0134$ mm

for He-Ne,

$$\lambda = \frac{2 \times d_{mean}}{N}$$

N = 50,

$$\lambda = \frac{2 \times 0.0134 \text{ mm}}{50}$$

$$= 5360 \text{ Å}$$

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In Michelson Interferometer, if M_1 is moved forward or backward, circular fringes appear or disappear at the centre. The mirror is moved through a known distance d and the number N of fringes appearing or disappearing at the centre is counted.

wavelength, $\lambda = \frac{2d}{N}$.

Procedure:

- Choose He-Ne Laser and switch it ON.
- Using the slider Adjust Micrometer, slowly change the micrometer distance, the fringes will displace. The distance moved for a fixed number of fringes can be noted from the values.
- The wavelength of the laser can be calculated and the calibration constant for the simulator is 1.
- Adjust the thickness once for the interferometer the note further readings for different fringes.

Result:

$\lambda_{observed} = 5360$ Å

$\lambda_{given\ for\ He\text{-}Ne} = 5430$ Å

$\%\ Error = \left|\frac{5430 - 5360}{5430}\right| \times 100 = 1.2\ \%$.

Teacher's Signature: _____