PHYF214 PHYSICS LAB REPORT SEM1 2018-2019
Lab 1 Group 7: Michelson Interferometer [MI]

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1 Experimental Tasks

1. To construct a Michelson interferometer, study the fringe patterns resulting from both a point source and a parallel beam, and make a precise measurement of the wavelength of the Diode laser.
2. To measure the index of refraction of a glass slide using the Michelson interferometer.

2 Apparatus

Bread board, diode laser, laser mount, beam splitter, three mirrors, rotating stage with a glass mount, screen.

3 Theory

By varying the optical path travelled by two beams, we can change the relative phase difference between two beams, thus when these are combined Interference patterns are observed. The Michelson interferometer uses this principle and is used to measure various parameters such as source wavelength, refractive index of an object and so on among many others.

4 Observations and Analysis

4.1 Part 1:Determination of wavelength

Least count of micrometer= 20 µm
One division in micrometer stage = 0.35 µm in translation stage.

No of Fringe shifts (n)	Micrometer count	Translation stage length (in mm) (d)	Wavelength $\lambda = \frac{2d}{n}$
20	24	0.0000084	840 nm
40	47	0.00001645	822.5 nm
60	71	0.00002485	828.3 nm
80	94	0.0000329	822.5 nm
100	116	0.0000406	812 nm

Average of measured wavelengths, $\lambda = \frac{840+822.5+828.3+822.5+812}{5} = 825\,\text{nm}$
standard deviation of the data $\sigma = 10.22\,\text{nm}$

The expected error is found from the formula
$\Delta\lambda = \lambda(\frac{\Delta D}{D} + \frac{\Delta N}{N})$
as 75.95 nm by taking ΔD as $\pm 0.35\,\mu\text{m}$ and ΔN as ± 1.
Thus our measurement error (σ) is within theerror range.

4.2 Part2: Determination of Refractive Index

Thickness t of the slide is found to be 1.35 mm.

No. of Fringe shifts (N)	Angle (in °) (θ)	Refractive index $\mu = \frac{(2t-N\lambda)(1-\cos\theta)}{2t(1-\cos\theta)-N\lambda}$
23	10	1.85
32	12	1.79
45	14	1.84
52	15	1.85

Average Refractive index $\mu = \frac{1.85+1.79+1.81+1.84+1.85}{4} = 1.83$. The standard deviation, σ of the obtained data is found to be 0.026.

5 Precautions

- The mirrors should be aligned properly and parallel.
- Place the lens properly and make sure the fringes are focused well.
- Do not put your hand near the apparatus because the apparatus are highly vibration sensitive.

6 Conclusions and Results

Through the experiment we have calculated the wavelength $\lambda = 825\,\text{nm} \pm 10.22\,\text{nm}$ and the refractive index μ of the glass slide is systematically calculated to be 1.83 ± 0.03.

The deviation of the obtained value from the expected value of $\mu = 1.5$ for glass could be attributed to error in calculation of wavelength $\lambda = 825$nm which is different from what the diode laser is rated at (635nm) . This could also be due to loss of the effectiveness of beam splitter and the polish on mirrors over time and repeated use .