–

DEPARTMENT OF SCIENCE AND HUMANITIES

I SEMESTER - R 2017

BS8161– PHYSICS LABORATORY

LABORATORY MANUAL

Name : ______________________________________

Register No : ______________________________________

Section : ______________________________________

VISION

College of Engineering is committed to provide highly disciplined, conscientious and enterprising professionals conforming to global standards through value based quality education and training.

MISSION

- To provide competent technical manpower capable of meeting requirements of the industry
- To contribute to the promotion of Academic excellence in pursuit of Technical Education at different levels
- To train the students to sell his brawn and brain to the highest bidder but to never put a price tag on heart and soul

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Fundamentals

To provide students with a solid foundation in Mathematics, Science and fundamentals of engineering, enabling them to apply, to find solutions for engineering problems and use this knowledge to acquire higher education.

2. Core competence

To train the students in Engineering Physics so as to apply their knowledge and training to compare, and to analyze various engineering industrial problems for finding solutions.

3. Breadth

To provide relevant training and experience to bridge the gap between theoretical learning and practice that enables them to find solutions for the real time problems in industry and to design products.

4. Professionalism

To inculcate professional and effective communication skills, leadership qualities and team spirit for the students to make them multi-faceted personalities and develop their ability to relate engineering issues to broader social context.

5. Lifelong learning/ethics

To demonstrate and practice ethical and professional responsibilities in the industry and society by and large, through commitment and lifelong learning needed for successful professional career.

PROGRAMME OUTCOMES (POs)

a) To demonstrate and apply knowledge of Mathematics, Science and Engineering fundamentals in Engineering physics

b) To determine the Moment of Inertia of given disc and Rigidity modulus of the given wire using Torsional Pendulum

c) To determine Young's modulus of a given bar using Non-Uniform bending

d) To utilize laser source and grating to estimate the wave length, particle size of given powder and Numerical Aperture & acceptance angle of given optical fiber

e) To find the Thermal conductivity of a bad conductor using Lee's Disc method

f) To Measure the velocity of ultrasonic wave in a liquid and compressibility of the liquid usingultrasonic Interferometer

g) To determine the wavelength of Hg source using grating and spectrometer

h) To find the thickness of a thin wire using Air- wedge method

i) To participate and succeed in competitive exams and visualize and work on laboratory and multidisciplinary tasks

BS 8161 – PHYSICSLABORATORY

(Common to all branches of B.E. / B.TechProgrammes)

SYLLABUS

COURSE OBJECTIVES

To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY(Any 5 Experiments)

1. Determination of Rigidity modulus – Torsion pendulum

2. Determination of Young' s modulus by Non uniform bending method

3. (a) Determination of Wavelength, and particle size using Laser.

(b) Determination of acceptance angle in an optical fiber.

4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.

5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer

6. Determination of wavelength of mercury spectrum – spectrometer grating

7. Determination of band gap of a semiconductor

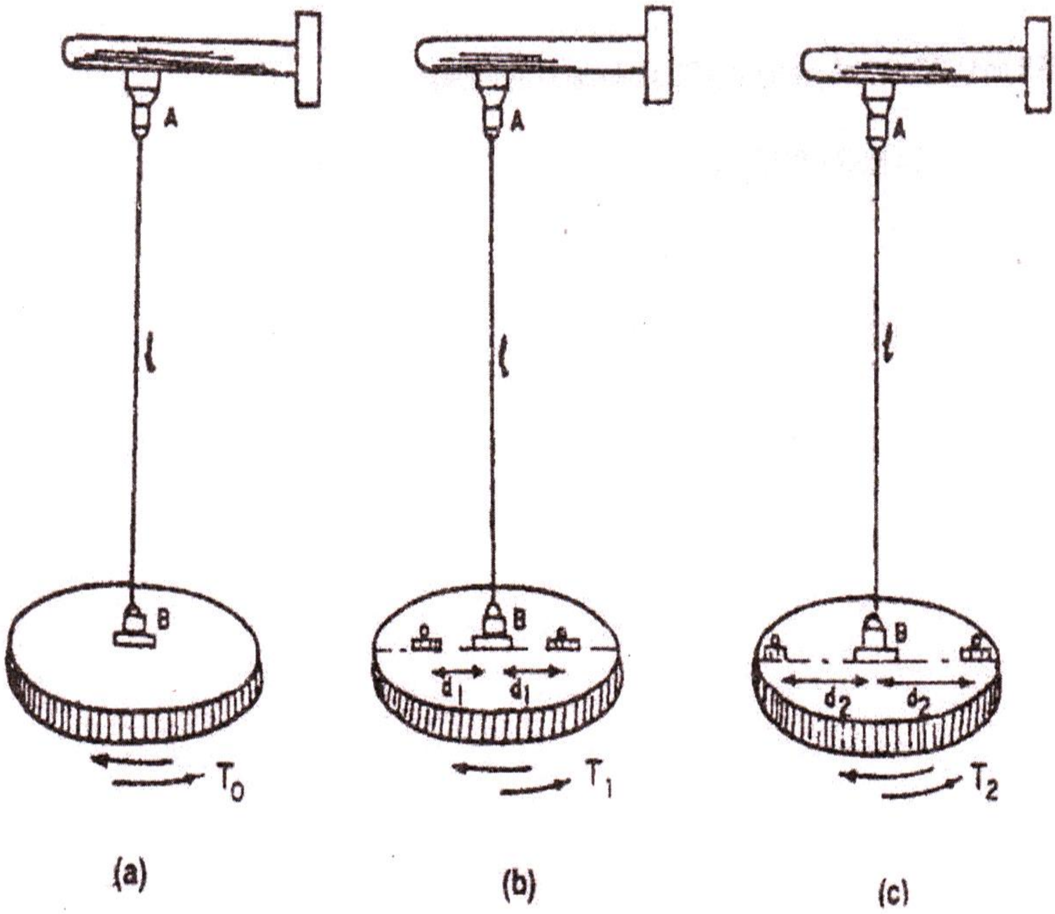
8. Determination of thickness of a thin wire – Air wedge method

COURSE OUTCOMES

Completion of the course, the students will be able to: apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

BS 8161 – PHYSICS LABORATORY

CONTENTS



TORSIONAL PENDULUM

Expt. No.1 TORSIONAL PENDULUM

AIM:

To determine the moment of inertia of the given disc and hence to determine the rigidity modulus of the material of the given suspension wire by torsional oscillations

APPARATUS REQUIRED:

Torsional pendulum, two equal masses, stop clock, screw gauge and meter scale

FORMULA:

Moment of Inertia of the disc, I = $\frac{2m(d_2^2-d_1^2)T_o^2}{T_2^2-T_1^2}$ kg m^2

Rigidity modulus of the wire, n = $\frac{8\pi Il}{T_o^2 a^4}$ Nm^{-2}

where

m –mass of the cylinder placed on the disc (kg)

T_o –period of the pendulum for a length of *l* without mass (s)

T_1–period of the pendulum for the same length when mass m is placed at a distance d_1 from the center of the suspension wire (s)

T_2–period of the pendulum for the same length when mass m is placed at a distance d_2 from the center of the suspension wire (s)

a – radius of the suspension wire (m)

1. To determine the time period of the disc:

Length of the wire (l)= -------- $\times 10^{-2}$ m

Position of the equal masses	Time for 10 oscillations			Time period (one oscillation) s
	Trial-1 s	Trial-2 s	Mean s	
Without any masses				T_0
With masses at d_1 = x10^{-2}m				T_1
With masses at d_2 = x10^{-2}m				T_2

2. To determine the radius of the wire:

Least count =0 .01 mm.

Zero Error ZE = --------- divisions

Zero Correction ZC = --------- mm

Sl.No.	Pitch Scale Reading PSR $\times 10^{-3}$ m	Head Scale Coincidence HSC div	Observed reading OR = PSR + (HSCXLC) $\times 10^{-3}$ m	Correct reading CR = OR ± ZC $\times 10^{-3}$ m

Mean = ---------------$\times 10^{-3}$ m

PROCEDURE:

Torsional pendulum is suspended from vertical chuck. The length of the suspension wire is measured between the vertical chuck and the chuck attached to the uniform circular disc (i). The circular disc is twisted slightly without masses on the disc. Now it executes torsional oscillations. Care is taken to see that the disc oscillates without wobbling. Time taken for 20 oscillations is noted with the help of a stop clock. Two trials are taken. The average of these two trial readings is calculated from which the period of oscillations is found out as T_0.

Two identical cylindrical masses each of mass m are symmetrically placed on the disc on either side of the wire at a distance d from the center of the disc. As before the disc is gently twisted. Time taken for 20 oscillations is noted from which the period of oscillation is calculated as T_1.

The cylindrical masses are placed at a distance d_2 from the center and the experiment is repeated. The mean time period of oscillations is calculated T_2.

The diameter of the specimen wire is measured accurately with the help of the screw gauge, at various places on the wire. The average diameter and hence the radius of the wire is calculated as r.

Moment of inertia and the rigidity modulus are determined by the substituting the value of m, T_0, T_1, T_2, T_3, and l in the formula.

CALCULATION:

Moment of Inertia of the disc, I = $\frac{2m(d_2^2-d_1^2)T_o^2}{T_2^2-T_1^2}$ kg m^2

Mass of cylindrical mass, m = ----------- × 10^{-3} kg

Closest distance of the mass from the centre of the suspension wire, d_1 = ------------ × 10^{-2} m

Farthest distance of the mass from the centre of suspension wire, d_2= ------------× 10^{-2} m

Period of oscillation without mass, T_o = ------------- s

Period of oscillation with mass at d1, T_1= ------------ s

Period of oscillation with mass at d2, T_2 = ------------- s

Moment of Inertia of the disc, I =$\frac{2m(d_2^2-d_1^2)T_o^2}{T_2^2-T_1^2}$ kg m^2

= --------------- kg m^2

= --------------- kg m^2

Rigidity modulus of the wire, n = $\frac{8\pi Il}{T_o^2 a^4}$ Nm^{-2}

Moment of inertia, I = ------------------ kg m^2

Length of the wire, l = ------------------- × 10^{-2} m

Time of oscillation, T_o = ------------------ s

Radius of the wire, a = ------------------- × 10^{-3} m

Rigidity modulus of the wire, n = $\frac{8\pi Il}{T_o^2 a^4}$ Nm^{-2}

= ----------------------

Rigidity modulus, n = ------------------- Nm^{-2}

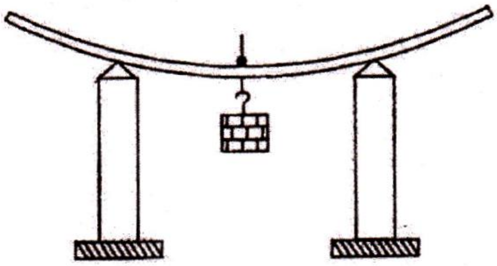
RESULT:

(i) The moment of inertia of the given circular disc, I = -------------- kg m^2

(ii) The rigidity modulus of the material of the given wire, n = ------------- Nm^{-2}

Viva – voce

1. State Hooke's law.
2. Define –Rigidity modulus
3. Define –Moment of inertia
4. What is meant by torsional oscillation?
5. What is period of oscillation?
6. What is meant by twisting couple?
7. Define – Shearing stress
8. Define – Shearing strain
9. What is the unit of rigidity modulus?
10. What are the applications of torsional pendulum?



Young's Modulus – Non Uniform Bending

To determine depression (y):

L.C =.001cm M = __________ $\times 10^{-3}$ kg

Sl.No	Load $\times 10^{-3}$ kg	Microscope reading						Mean $\times 10^{-2}$ m	Depression y for M kg $\times 10^{-2}$ m
		Loading			Unloading				
		MSR $\times 10^{-2}$ m	VSC div	TR $\times 10^{-2}$ m	MSR $\times 10^{-2}$ m	VSC div	TR $\times 10^{-2}$ m		
1	W								
2	W+50								
3	W+100								
4	W+150								
5	W+200								
6	W+250								

Mean (y) = ---------- $\times 10^{-2}$ m

Expt. No.2 YOUNG'S MODULUS BY NON – UNIFORM BENDING

AIM:

To determine the young's modulus of the material of the given bar, by non-uniform bending method

APPARATUS REQUIRED:

Travelling microscope, wooden bar, knife- edge, weights hanger, slotted weight, vernier calipers, screw gauge and pin

FORMULA:

Young's modulus of the material of the material of the given bar, E = $\frac{Mgl^2}{4bd^3y}$ Nm^{-2}

Where,

g – acceleration due to gravity (9.8 ms^{-2})

l – length of the bar between two knife edges (m)

b – breadth of the bar (m)

d – thickness of the bar (m)

y – depressiont in the scale reading due to the change of mass M (m)

PROCEDURE:

The given wooden bar, for which young's modulus is to be determined, is paced symmetrically on the two knife edges. The distance between the knife edges is measured as the length of the bar (l). It is adjusted to be, say, 60 cm. the weight hanger is suspended at the centre of the bar. A pin is held vertically at the centre of the bar with the help of wax.

The given bar is brought to elastic mood by loading and unloading the bar with slotted weights in steps of 50 g. This is repeated for two or three times. With the hanger as dead load W, the microscope is focused on to the tip of the pin. The tangential screw of the microscope is adjusted so that the image of the tip of the pin just touches the horizontal cross wire of the eyepiece. The main scale reading and the vernier scale coincidence corresponding to this position are noted.

To find the breadth using vernier calipers, b:

Least count = ---------- cm

= ---------- $\times 10^{-2}$ m

Zero error = --------- div.

Zero correction = $\pm$ZE $\times$LC= --------- $\times 10^{-2}$ m

Sl. No.	MSR $\times 10^{-2}$ m	VSC div.	Observed reading OR = MSR+(VSC $\times$ LC) $\times 10^{-2}$ m	Correct Reading CR = OR $\pm$ ZC $\times 10^{-2}$ m
1.				
2.				
3.				

Mean, b = ----------------------$\times 10^{-2}$ m

To find the thickness using screw gauge, d:

Least count = ---------- mm

= ---------- $\times 10^{-3}$ m

Zero error = --------- div.

Zero correction =ZE $\times$LC= --------- $\times 10^{-3}$ m

Sl. No.	PSR $\times 10^{-3}$ m	HSC div.	Observed reading OR = PSR+ (HSC $\times$ LC) $\times 10^{-3}$ m	Correct Reading CR = OR $\pm$ ZC $\times 10^{-3}$ m
1.				
2.				
3.				

Mean, d = ------------------------$\times 10^{-3}$ m

The experiment is repeated by adding weights in steps of 50 g and every time the microscope is adjusted for coincidence. The corresponding readings are noted. The experiment is repeated by unloading the weights in steps of 50 g and the corresponding readings are tabulated. From this table, the shift in the scale reading, say y, for a change of mass M is found out.

The breadth of the bar is measured at various points with the help of vernier calipers. Similarly the thickness of the bar is measured by screw gauge. Substituting the values of M, y, l, d, b and g in the formula, the young's modulus of the material of the given bar is calculated.

CALCULATION:

Young's modulus of the material of the material of the given bar, E = $\frac{Mgl^2}{4bd^3y}$ Nm^{-2}

Acceleration due to gravity, $g = 9.8\ ms^{-2}$

Length of the bar between two knife edges, l = ------------ $\times 10^{-2}$ m

Breadth of the bar, b = ----------- $\times 10^{-2}$ m

Thickness of the bar, d = ----------- $\times 10^{-3}$ m

y = -----------$\times 10^{-2}$ m

$$E = \frac{Mgl^2}{4bd^3y} \quad Nm^{-2}$$

= ----------------

Young's modulus, E = ----------- Nm^{-2}

RESULT:

Young's modulus of the material of the given bar, E = ---------- Nm^{-2}

Viva – voce

1. Define – Young's modulus

2. What is meant by Non-uniform bending?

3. Define – Stress and strain

4. State Hooke's law.

5. Define – Neutral axis

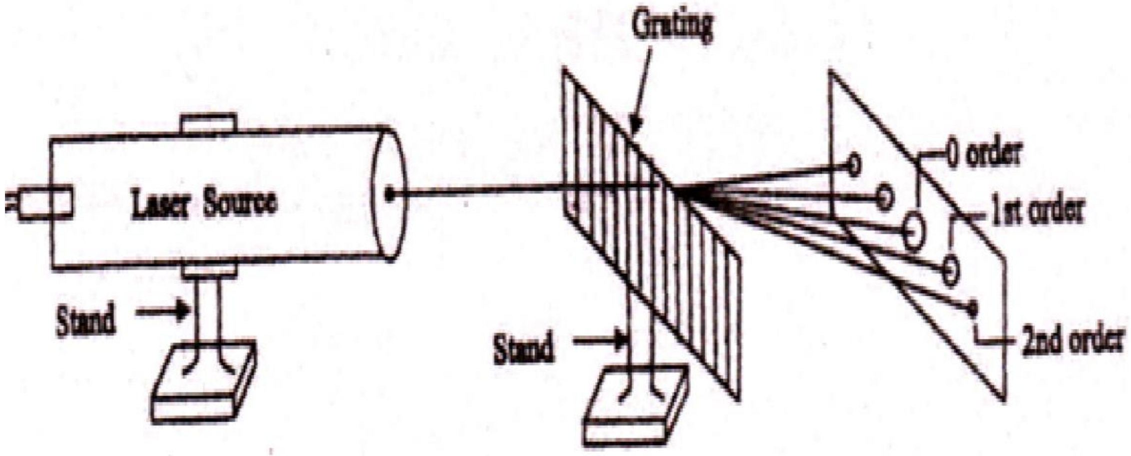
6. What is the SI unit of young's modulus?

7. Define – Elastic limit

8. Define – Elasticity

9. What are the factors affecting elasticity?

10. Define – Elastic fatigue



To find the wavelength of the laser beam, λ:

Distance between the screen and the grating, D = ------------$\times 10^{-2}$ m

Number of lines per meter length of the grating, N = --------------- Lines per meter

Sl. No.	Order of diffraction, (m)	Reading of the diffracted image ($\times 10^{-2}$ m)			$\theta_m = tan^{-1}(\frac{x_m}{D})$ (deg.)	$\lambda = \frac{sin\theta_m}{mN}$ m
		Left side (x_l)	Right side (x_r)	Mean (x_m)		

Mean, λ = --------------- m

Expt. No.3(a) WAVELENGTH OF LASER LIGHT AND PARTICLE SIZE

AIM:

(i) To determine the wavelength of the given laser light.

(ii) To determine size of the given particle.

APPARATUS REQUIRED:

Diode laser, grating, screen, given micro particles, scale and screen.

FORMULAE:

(i) Wavelength of the given laser source of light, $\lambda = \frac{\sin\theta_m}{mN}$ m

(ii) Grain size or diameter of the grain, 2d = $\frac{n\lambda D}{x_n}$ m

Where

θ_m –angle of diffraction (deg.)

M –order of diffraction (No unit)

N –number of lines per metre length of the grating (m^{-3})

n – order of diffraction (no unit)

λ – wavelength of laser light used (m)

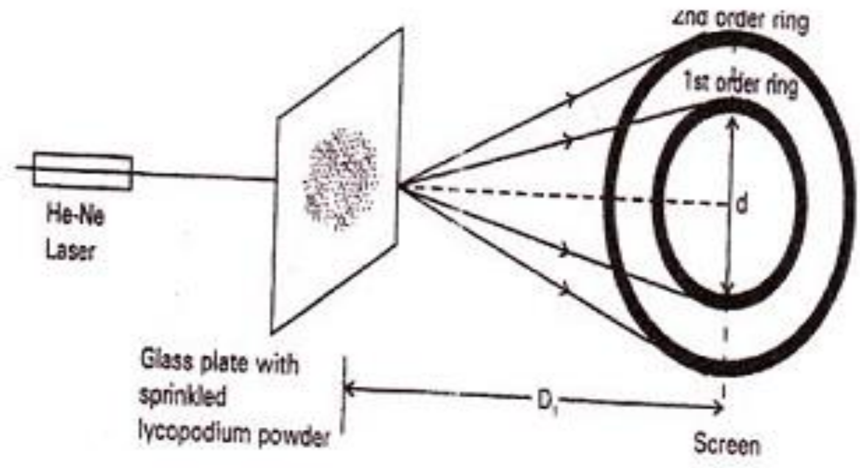
D – distance between the glass plate and the screen (m)

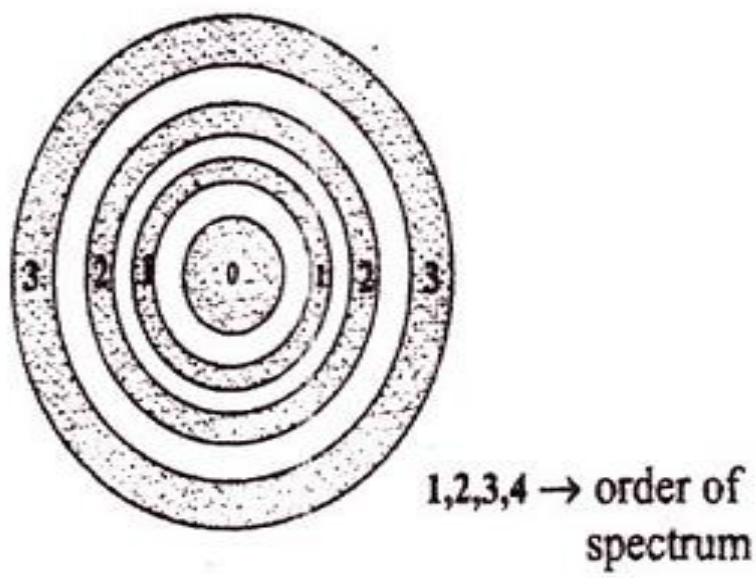
x_n - distance between the central bright spot and the nth fringe (m)

PROCEDURE:

TO FIND THE WAVELENGTH OF THE GIVEN LASER LIGHT:

The laser source, grating and screen are placed properly as shown in figure. The diode laser is kept horizontally and switched on. Extreme care should be taken to avoid direct exposure of laser light on eyes.


2nd order ring
1st order ring
d
He-Ne
Laser
Glass plate with
sprinkled
lycopodium powder
D
Screen


3
2
1
0
1
2
3
1,2,3,4 → order of
spectrum

The grating is held normal to the laser beam by adjusting the grating in such a way that the reflected laser beam from the grating coincides with incident laser beam. Now the diffracted laser spots of various orders can be seen on the screen, placed on the other side of the grating.

The distance of the different orders on either side of the central spot are measured as $x_r$andx_l and are tabulated.The mean value of $x_r$and$x_l$are calculated as x_m for the mth order diffracted light. The distance between the grating and the screen is measured as D. Hence, the angle of diffraction for the mth order,

$$\theta_m = tan^{-1}\left(\frac{x_m}{D}\right)$$

The experiment is repeated for different orders and the readings are tabulated. From the table, θ for each order is calculated. Substituting the value of θ, the corresponding order of diffraction and the number of lines per meter length of the grating, the wavelength is calculated.

TO FIND THE SIZE OF THE GIVEN MICRO PARTICLE:

The lycopodium powder having fine micro particles of nearly same size is sprinkled on a glass plate. This glass plate is kept between laser source and screen.

Now the particles present in the glass plate diffract laser beam from the source. By adjusting the distance between the glass plate and the screen, a circular fringe pattern is obtained on the screen with different orders of fingers. Now distance between the screen and the glass plate (D) is measured.

The distance of the first order and the second order fringe from the centre of spot are also measured. Using the formula, the particle size is found out. The experiment is repeated for different D values.

To find the size of the particle:

Sl.No	Distance between screen and glass plate(D) $\times 10^{-2}$ m	Order of diffraction (n)	Distance between the central bright spot and n^{th} fringe (x_n) $\times 10^{-2}$ m	Particle size $2d = \frac{n\lambda D}{x_n}$ m

CALCULATION:

(i) Wavelength of the given laser source of light, $\lambda = \frac{sin\theta_m}{mN}$ m

Number of lines per metre in the grating, N = ------------ lines per metre.

First order, m_1; θ_1 = ------------

Wavelength, $\lambda = \frac{sin\theta_1}{mN}$ = ------------

Second order, m_2; θ_2 = ------------

Wavelength, $\lambda = \frac{sin\theta_2}{mN}$ = ------------

Third order, m_3; θ_3 = ------------

Wavelength, $\lambda = \frac{sin\theta_3}{mN}$ = ------------

Fourth order, m_4; θ_4 = ------------

Wavelength, $\lambda = \frac{sin\theta_4}{mN}$ = -------------

Fifth order, m_5; θ_5 = ------------

Wavelength, $\lambda = \frac{sin\theta_4}{mN}$ = ------------

Mean wavelength of the given laser light, λ = ------------- m

(ii) Grain size or diameter of the grain. $2d = \frac{n\lambda D}{x_n}$

Order of differaction, n = -------------

Wavelength of laser light used, λ = ------------ m

Distance between glass plate and the screen, D = ------------ m

Distance between central bright spot and the n^th fringe, x_n = ------------ m

$$2d = \frac{n\lambda D}{x_n}$$

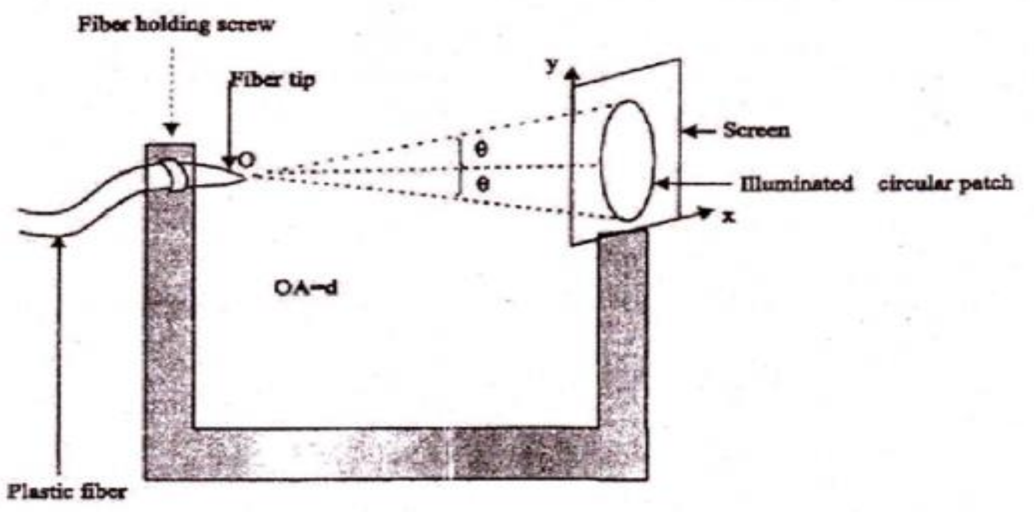
=

= ------------ m

RESULT:

(i) Wavelength of the laser beam, λ = ------------- m

(ii) Average size of the particle = -------------- m



Optical fiber

To find numerical aperture, NA:

Sl. No.	Diameter of the circular patch D(m)	Distance between the tip of the fiber and the screen X (m)	NA = $\frac{D}{(4X^2+D^2)^{\frac{1}{2}}}$

Mean NA =

Therefore, the acceptance angle, θ = Sin^{-1} (NA) = ------------------

= ------------------

Expt. No.3(b) NUMERICAL APERTURE AND ACCEPTANCE ANGLE

AIM:

To measure the numerical aperture and the acceptance angle of the given fiber cable

APPARATUS REQUIRED:

Optical fiber cable with source, NA jig and in-line adaptor

FORMULA:

The numerical aperture, NA = $\frac{D}{(4X^2+D^2)^{\frac{1}{2}}}$

Acceptance angle, $\theta = \text{Sin}^{-1}$ (NA)

where,

D – diameter of the circular patch (m)

X – distance between the tip of the fiber and the screen (m)

PROCEDURE:

One end of the one metre fiber cable is connected to the laser light source and the other end to the NA jig as shown in figure. The AC main is plugged in and the laser light is adjusted so that it appears at the end of the fiber on the NA jig, the intensity knob is adjusted to get maximum intensity.

The white screen with the four concentric circles (10 mm, 20 mm, 30 mm and 40 mm diameter) is held vertically at a suitable distance to make the red spot from the emitting fiber coincides with the 10 mm circle, the diameter (D) of the spot is noted. The distance (X) of the screen from the fiber end is recorded.

The procedure is repeated for 20 mm, 30 mm, 40 mm diameter circles and the readings are tabulated.

RESULT:

The numerical aperture, NA = ----------------

Acceptance angle, θ = ----------------

Viva – voce

1. What is semiconductor diode laser?

2. What is meant by active material in laser?

3. What is meant by LASER?

4. What is stimulated emission?

5. What are the characteristics of laser radiation?

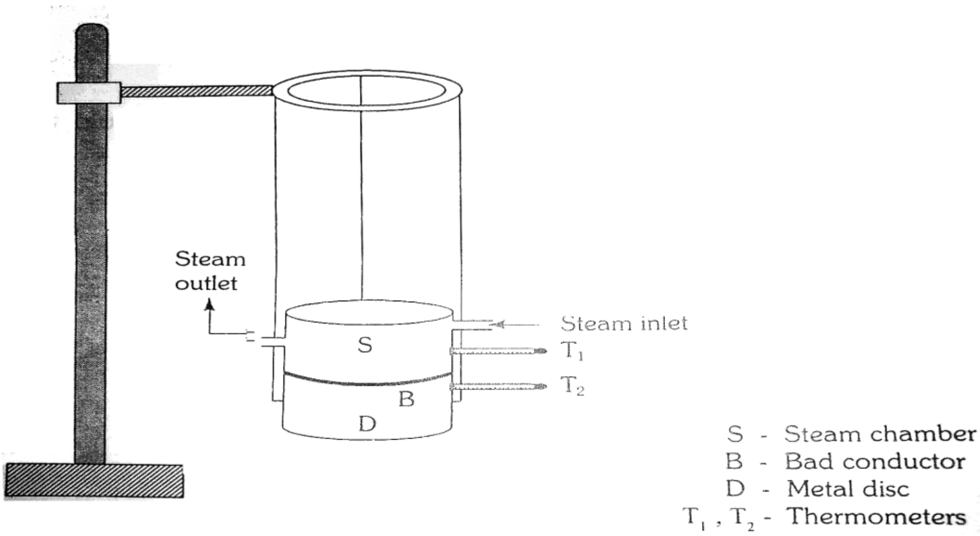
6. What is homo–junction laser?

7. What is hetero–junction laser?

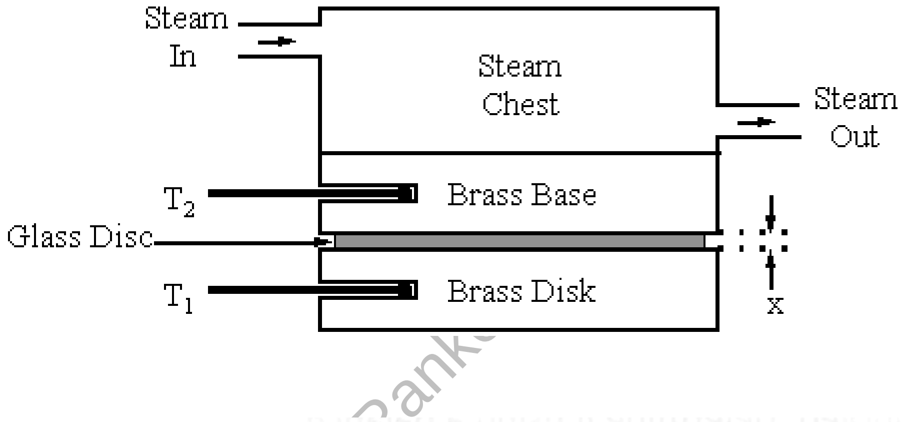
8. What are the applications of semiconductor laser?

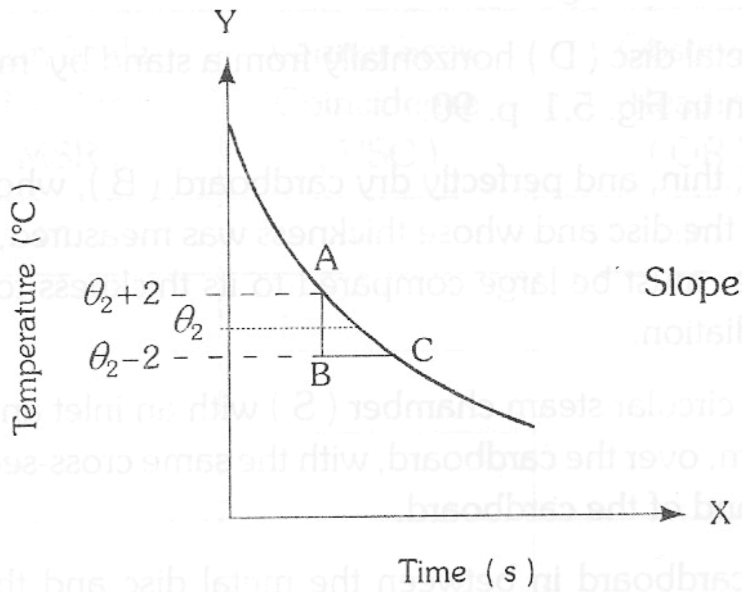
9. What are the conditions required for laser action?

10. Define – Numerical aperture



Lee's disc setup





$$\text{Slope at } \theta_2 = \left(\frac{d\theta}{dt}\right)_{\theta_2} = \frac{AB}{BC}$$

Expt. No. 4 THERMAL CONDUCTIVITY OF A BAD CONDUCTOR BY LEE'S DISC METHOD

AIM:

To determine the coefficient of thermal conductivity of a bad conductor

APPARATUS REQUIRED:

Lee's disc apparatus, bad conductors, stop-clock, thermometers, screw gauge, vernier calipers and steam boiler

FORMULA:

Thermal conductivity of a bad conductor, $K = \dfrac{MS\left(\dfrac{d\theta}{dt}\right)d(r+2h)}{\pi r^2(\theta_1-\vartheta_2)(2r+2h)} Wm^{-1}k^{-1}$

M – Mass of the metallic disc (Kg)

S – Specific heat capacity of the metallic disc (J Kg^{-1} K^{-1})

$\left(\dfrac{d\theta}{dt}\right)_{\theta_2}$ – rate of cooling at steady temperature (°C/s)

d – thickness of the bad conductor (m)

h – thickness of the metallic disc (m)

r–radius of the metallic disc (m)

θ_1 – steady temperature of the steam chamber (°C)

θ_2 – steady temperature of the Metallic disc (°C)

PROCEDURE:

The thickness of the bad conductor say card board and thickness of the metallic disc are determined using a screw gauge. The radius of the metallic disc is found using a vernier caliper. The mass of a metallic disc is also found using a common balance. The readings are tabulated.

To find the radius of the metallic disc (r) using Vernier Calipers

Least count = 0.01cm

Zero error = ± ....div

Zero correction = ± ....cm

= --------- $\times 10^{-2}$ m

Sl.No.	MSR ($x10^{-2}$ m)	VSC (div.)	OR = MSR +(VSC x LC) ($x10^{-2}$ m)	CR = OR ± ZC ($x10^{-2}$ m)
1				
2				
3				
4				

Mean radius, r = ------------------------------- $x10^{-2}$ m

To find the thickness of the bad conductor (d) using Screw gauge

Least count = 0.01mm

Zero error = ± ....div

Zero correction = ± ....mm

Sl.No.	PSR ($x10^{-3}$m)	HSC (div.)	OR = PSR + (HSC x LC) ($x10^{-3}$ m)	CR = OR ± ZC ($x10^{-3}$ m)
1.				
2.				
3.				
4.				

Mean, d = ------------------------------- $x10^{-3}$ m

The whole Lee's disc apparatus is suspended from a stand as shown in the figure. The given bad conductor is placed in between the metallic disc and the steam chamber. Two thermometers **T_1** and **T_2** are inserted into the respective holes.

Steam from the steam boiler is passed into the steam chamber until the temperature of the steam chamber and the metallic disc are steady. The Steady temperature (**θ_1**) of the steam chamber and (**θ_2**) of the metallic disc recorded by the thermometers are noted.

Now the bad conductor is removed and the steam chamber is placed in direct contact with the metallic disc. The temperature of the disc rapidly rises. When the temperature of the disc rises about 10°Cabove **θ_2**°C, the steam chamber is carefully removed after cutting of the steam supply.

When the temperature of the disc reaches **10**°C above the steady temperature of the disc i.e. **(θ_2+ 10)**°C , stop clock is started. Time for every one degree celsius fall of temperature is noted until the metallic disc attains a temperature (θ_2 - 10) °C.

A graph is drawn taking time along the x-axis and temperature along the y-axis. The cooling curve is obtained .To obtain the rate of the cooling $\left(\frac{d\theta}{dt}\right)_{\theta_2}$ from this graph, a triangle is drawn by taking 1°C above and 1°Cbelow the steady temperature **θ_2**. Then the slope AB / BC gives the rate of cooling at$\left(\frac{d\theta}{dt}\right)_{\theta_2}$. From these readings and using the given formula thermal conductivity of the given bad conductor is calculated.

To find the thickness of the metallic disc (h) using screw gauge

Least count = 0.01mm

Zero error = ± ....div

Zero correction = ± ....mm

Sl.No.	PSR ($x10^{-3}$ m)	HSC (div.)	TR = PSR + (HSC x LC) ($x10^{-3}$ m)	Corrected reading CR = TR ± ZC ($x10^{-3}$ m)
1				
2				
3				
4				
5				

Mean, h = ---------------------------- $x10^{-3}$ m

To determine the rate of cooling of metallic disc:

Time s	Temperature °C	Time s	Temperature °C

CALCULATION:

Mass of the disc, m= ---------- x10^{-3} kg

Specific heat capacity of the disc,c = 385 J $kg^{-1}K^{-1}$

Rate of cooling at θ_{2}, $\frac{d\theta}{dt}$= ------------- deg s^{-1}

Radius of the disc, r = ---------- x10^{-2} m

Height of the disc, h = ---------- x10^{-2} m

Thickness of the bad conductor, d = ---------- x10^{-3} m

Temperature of steam, θ_1 = --------- ^{o}C

Steady temperature of the disc, θ_2 = ------------ ^{o}C

Thermal conductivity, $K = \dfrac{MS\left(\dfrac{d\theta}{dt}\right)d\left(r+2h\right)}{\pi r^{2}\left(\theta_1-\vartheta_2\right)\left(2r+2h\right)} Wm^{-1}k^{-1}$

= --------------------

= -------------------- $Wm^{-1}K^{-1}$

RESULT:

The thermal conductivity of the given bad conductor by Lee's disc method, K = -------------- $Wm^{-1}K^{-1}$

Viva – voce

1. What is meant by thermal conductivity?

2. What is meant by Rate of cooling?

3. Does the value of thermal conductivity depend on the dimension of the specimen?

4. Is there any reason to take the specimen in the form of a disc?

5. Can this method be used for good conductors?

6. What is lee's disc method?

7. What are the differences between good conductor and bad conductor?

8. What are the methods used to determine thermal conductivity of bad conductor?

9. What is meant by steady temperature?

10. What is meant by specific heat capacity?

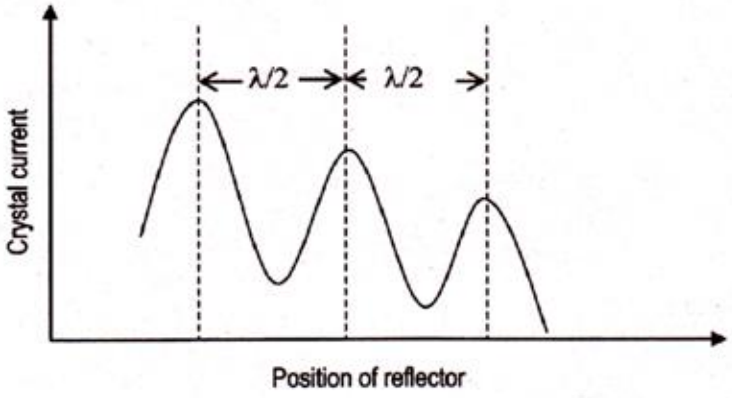


Figure 9.1 Variation of crystal current

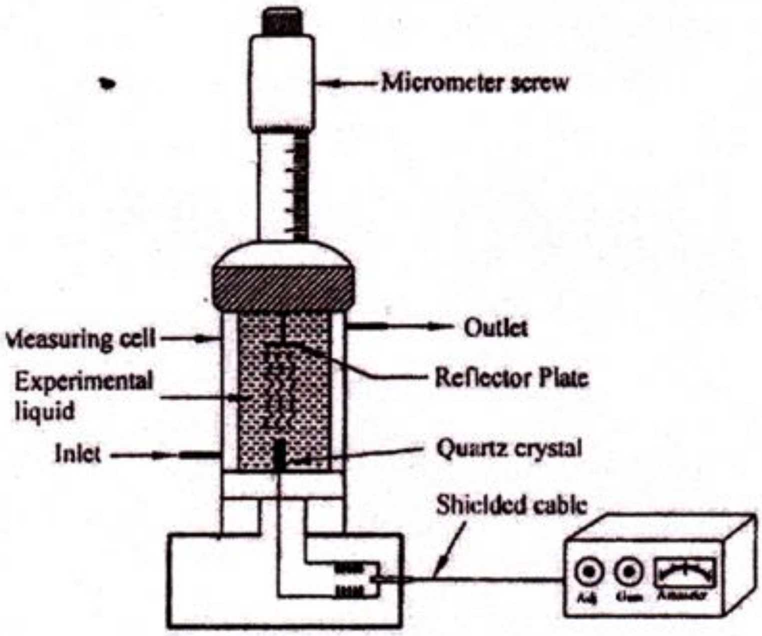


Figure - Ultrasonic Interferometer

Exp. No. 5 ULTRASONIC INTERFEROMETER

AIM:

To determine the velocity of the ultrasonic waves in a given liquid and to find the compressibility of the liquid using ultrasonic interferometer

APPARATUS REQUIRED:

Ultrasonic interferometer (high frequency) generator, measuring cell, the experimental liquid and coaxial cables

FORMULA:

1) Velocity of the ultrasonic waves v = f λ ms^{-1}

where,

f –frequency of the ultrasonic waves (Hz)

λ – wavelength of the ultrasonic waves in the liquid (m)

2) Compressibility of the liquid $\beta = \frac{1}{v^2\rho}$ m^2N^{-1}

where

ρ – density of the given liquid ($kg\ m^{-3}$)

v– velocity of the ultrasonic waves with in the liquid ($m\ s^{-1}$)

DESCRIPTION:

The interferometer consists of (i) high frequency generator and (ii) measuring cell. The high frequency generator is used to excite the quartz plate fixed at the bottom of the measuring cell.

The exited quartz plate generates ultrasonic waves in the experimental liquid contained in the cell. A micro ammeter is provided to observe the change in the current.

Two control knobs are also provided in the generator for the purpose of sensitivity regulation and also adjustment. The measuring cell is a double walled cell to maintain constant temperature during

To find the wavelength of the ultrasonic waves in the liquid:

Order of maximum current	Micrometer reading			Distance for n maximum current, d ($x10^{-3}$ m)	Wavelength $\lambda=2d/n$ ($x10^{-3}$ m)
	PSR ($x10^{-3}$ m)	HSR (div)	TR ($x10^{-3}$ m)		
x x+n x+2n x+3n					

Wavelength, λ = ------------------ $x10^{-3}$ m

Frequency of ultrasonic waves = 2 MHz

CALCULATION:

1) The Velocity of the ultrasonic waves, v = fλ

= ---------- m s^{-1}

The density of the given liquid ρ = ---------- kg m^{-3}

2) Adiabatic compressibility of the liquid, $\beta = \frac{1}{v^2 \rho}$

= -----------

Adiabatic compressibility of the liquid, β = --------------

experiment.A fine micrometer arrangement is fixed at the top of the interferometer, enables the reflector pates to move upward or downward through a known distance.

PRINCIPLE:

The velocity of the ultrasonic waves is determined using the interferometer. The principle used in the measurement of velocity is based on the accurate determination of the wave length (λ) of ultrasonic waves in the liquid. The ultrasonic waves are reflected back by a removable metallic plate parallel to the crystal .These two ultrasonic waves superimpose producing stationary wave pattern within the medium.

If the separation between these two plates is exactly an integral multiple of λ/2 of the ultrasonic waves, acoustic resonance is produced in the standing waves.

This acoustic resonance gives rise to an electrical reaction on the generator and the anode current of the generator becomes maximum.

PROCEDURE:

The measuring cell is connected to the output terminal of the high frequency generator through a shielded cable. The cell is filled with an experimental liquid before switching on the generator. The ultrasonic waves move normally from the quartz crystal till they are reflected back from the movable plate and the standing waves are formed in the liquid in between the reflector plate and the quartz crystal.

The micrometer is slowly moved till the anode current of the high frequency generator shows a maximum in the meter. Now the initial reading of the micrometer screw is noted. If the micrometer is rotated in the same direction, the current various between minimum and maximum.Micrometer screw is rotated in the same direction until n^{th} maximum in the micro ammeter is reached. The reading in the micrometer is noted.

For n number of maximum anode current, the distance moved (d) is measured with the help of micrometer. Hence

$d = n\lambda/2$Therefore, $\lambda = 2d/n$

The frequency of the ultrasonic waves is noted as f (Hz)

The experiment is repeated for various n number of maximum and the readings are tabulated. Knowing the meaning value of λ, the velocity of the ultrasonic waves is calculated.

If the distance is now increased or decreased and the variation is exactly one half wavelengths ($\lambda/2$) or multiple of it, anode current becomes maximum. From the knowledge of wave length (λ) the velocity v can be obtained using the following relation.

$$v = f\,\lambda$$

By substituting the value of the density of the given liquid and the velocity of the ultrasonic waves in the given liquid, the adiabatic compressibility of the given liquid is calculated.

RESULT:

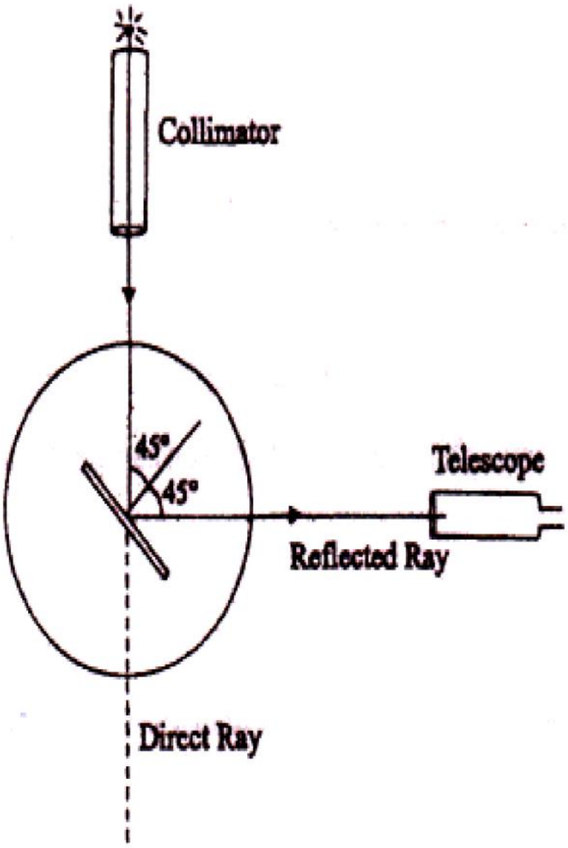
i) Wave length of the ultrasonic waves in the liquid = ---------- m

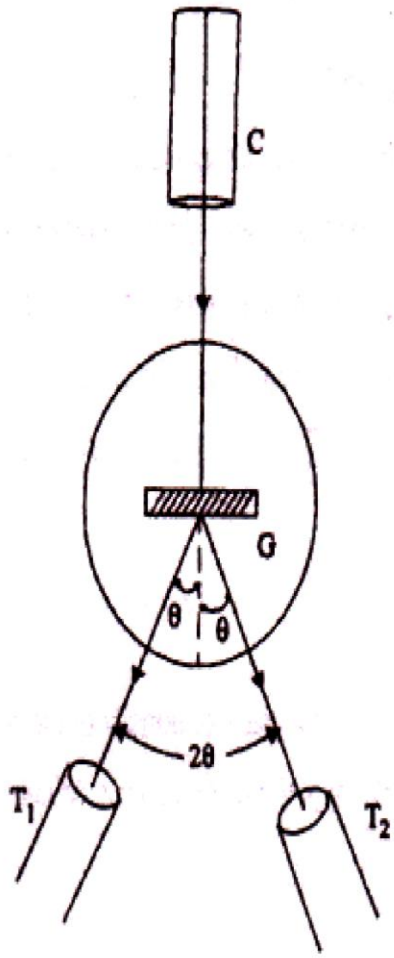
ii) Velocity of the ultrasonic waves in the liquid = --------- m s^{-1}

iii) Compressibility of the given liquid = --------- $N^{-1}m^{2}$

Viva – voce

1. What are ultrasonic waves?
2. Define Piezo – Electric effect
3. Explain inverse Piezo – Electric effect
4. Is ultrasonic wave,an electro-magnetic wave? Explain.
5. What is meant by acoustical grating?
6. Give the properties of ultrasonic waves.
7. What are the methods used to produce ultrasonic waves?
8. What is meant by SONAR?
9. What is meant by Compressibility?
10. What are the applications of ultrasonic waves?





Normal Incidence

Angle of diffraction

Exp. No. 6 **SPECTROMETER - GRATING**

AIM:

To standardize the grating using sodium vapour lamp and to use it to find the wavelength of the mercury spectra using spectrometer

APPARATUS REQUIRED:

Spectrometer grating, sodium vapour lamp and mercury vapour lamp

FORMULA:

Wavelength of the spectral line $\lambda = \frac{\sin\theta}{Nm}$ m

θ – angle of diffraction (deg.)

N – number of lines / meter length of the grating (m^{-1})

M – order of the spectra (No unit)

PROCEDURE:

The preliminary adjustments of the spectrometer are done.

To adjust for normal incidence:

a) The slit of the collimator is illuminated by the sodium vapour lamp. The telescope is brought in the line with the direct ray. The tangential screw of the telescope is adjusted so that the vertical cross wire coincides with the direct ray. The direct ray reading in the Vernier is rotated.

b) The telescope is turned through 90° in any direction and is fixed.

c) The grating is mounted vertically on the prism table. On viewing through the telescope, the grating alone is rotated until the reflected image of the slit is obtained. The grating is slightly adjusted so that the reflected image is made to coincide with the vertical cross wire. The grating is fixed at this position.

d) Now the vernier is released and is rotated along with the grating through 45° in the proper direction and is fixed. Now the grating is normal to the direct ray. This is the normal incidence position.

To find the wavelength, λ:

Least count =...........

Colour	Spectrometer reading												Difference, 2θ (deg.)			θ
	Left						Right									
	Vernier A (deg.)			Vernier B (deg.)			Vernier A (deg.)			Vernier B (deg.)			Ver.A	Ver.B	Mean	
	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR				

To find N:

The telescope is turned left or right to view the diffracted image of the slit. The telescope is brought in line with the first order image and is fixed. The readings given by the both the verniers are noted. The telescope is brought to other end. As before the readings are taken. This difference between these readings gives 2θ from which, θ is calculated.

Substitutingθ, λ for sodium light and m = 1, the number of lines per meter length of the grating is calculated.

To find the wavelength,λ:

Sodium vapour lamp is replaced by mercury lamp without disturbing the position of the grating. On either side of the direct white ray, mercury spectrum of different order is obtained.

The telescope is moved towards left side of the direct ray and is made to coincide with the prominent colours of the first order, starting from red to violet and the corresponding vernier readings are noted. Then the telescope is moved towards right side of the direct ray and as before the experiment is repeated from violet to red. The corresponding readings are noted.

The readings are tabulated and from this, the angle of diffraction for each colour is calculated .substituting the value for each colour, N and m the wavelength of each colour of light are calculated.

CALCULATION:

To find N:

No of lines per meter length of the grating, N = ---------------------- lines per metre.

To find the wavelength,λ:

No of lines per meter, N = ------------

Order of spectra, m = -------------

Wavelength of the spectral line, $\lambda = \frac{sin\theta}{Nm}$ m

Substituting the angle of diffraction for different colours, the wavelength for

Violet, $\lambda = \frac{sin\theta}{Nm} =$ = ----------x10^{-7} m= ----------- Å

Blue, $\lambda = \frac{sin\theta}{Nm} =$ = ----------x10^{-7}m = ----------- Å

Green, $\lambda = \frac{sin\theta}{Nm} =$ = ------------x10^{-7}m = ----------- Å

Yellow 1, $\lambda = \frac{sin\theta}{Nm} =$ =------------x10^{-7}m= ----------- Å

Yellow 2, $\lambda = \frac{sin\theta}{Nm} =$ =-------------x10^{-7}m = ----------- Å

Red, $\lambda = \frac{sin\theta}{Nm} =$ = ----------- x10 $^{-7}$m= ----------- Å

RESULT:

No of lines per meter length of the grating, N = ------------- lines/ meter

The wave length of the mercury spectra is given below

Colour	Wavelength (Å)
Violet	
Blue	
Green	
Yellow 1	
Yellow 2	
Red	

Viva – voce

1. What is the condition for diffraction?

2. What is plane transmission diffraction grating?

3. How are commercial gratings made?

4. What type of grating do you use for your experiment?

5. What is meant by monochromatic source?

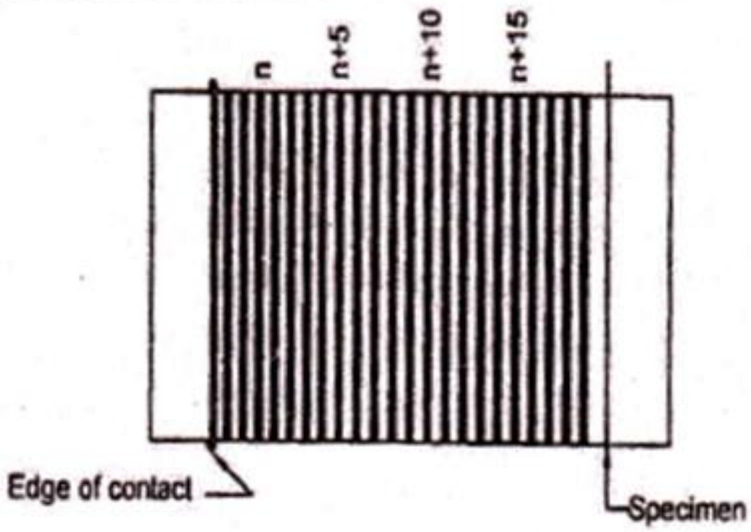
6. What is meant by polychromatic source?

7. Which color has higher wavelength?

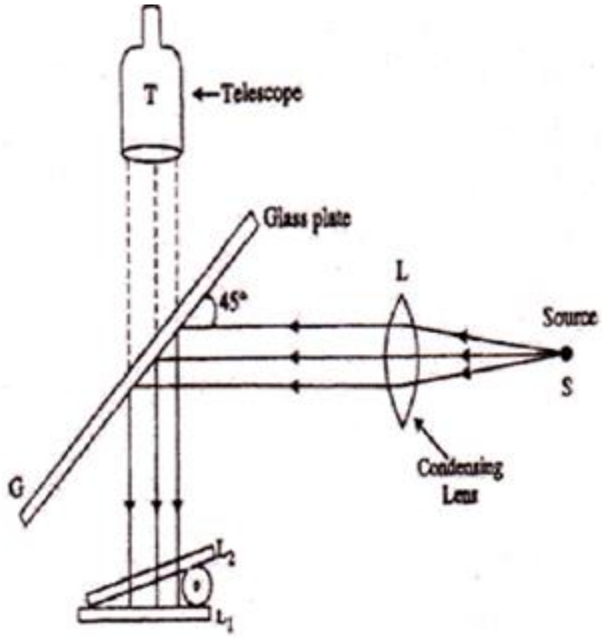
8.What is meant by normal incidence?

9. Which color has least wavelength?

10. What is meant by spectrometer?



Interference fringes



L_1, L_2 - Transparent plane glass plates   w - Specimen (wire)

AIR WEDGE ARRANGEMENT

Expt. No. 7 DETERMINATION OF THICKNESS OF A THIN WIRE

AIM:

To determine the thickness of the given wire using air wedge method

APPARATUS REQUIRED:

Vernier microscope, two optical plane rectangular glass plates, sodium vapour lamp, thin wire, glass plate and condensing lens

FORMULA:

Thickness of the wire, $t = \frac{L\lambda}{2\beta}$ m

where,

λ – wavelength of the sodium light (5893 Å)

L –distance of the wire from the edge of the contact (m)

β – mean fringe width (m)

PROCEDURE:

Two optical plane glass plates are placed one over another. One of their edges is tied with rubber band. The given wire is placed in between the two plates at the other end. This forms an air wedge arrangement.

This arrangement is placed on the horizontal bed of the vernier microscope. Light from the sodium vapour lamp is rendered parallel with the help of a condensing lens. The parallel beam of the light is allowed to fall on a glass plate inclined at 45°. The refracted light from the plate is made to fall vertically on the air wedge. The interference pattern is seen through the eye-piece of the microscope held just above the air wedge.

Large number of equi-spaced alternative bright and dark fringes can be seen. The vertical cross wire is made to coincide with any one of the dark fringes (n) at one end. The microscope reading given by the vertical scale is noted. Then the cross wire is made to coincide with n + 5, n + 10, n + 15 etc., up to n+50 and the corresponding reading are noted. The readings noted are tabulated and from the reading, bandwidth is β calculated. The distance between the wire and the edge of contact is measured with the microscope. Assuming the wavelength of sodium light, the thickness of the wire is determined

Determination of the Band Width (β):

Travelling Microscope Readings: L.C =0.001cm

Sl.No.	Order of the band	Microscope Reading			Width of 10 bands $\times 10^{-2}$ m	Mean Width of one band (β) $\times 10^{-2}$ m
		MSR $\times 10^{-2}$ m	VSC div	TR=MSR+(VSCxLC) $\times 10^{-2}$ m		
1	n					
2	n+5					
3	n+10					
4	n+15					
5	n+20					
6	n+25					
7	n+30					
8	n+35					
9	n+40					
10	n+45					

Mean (β) = __________ x10^{-2} m

To Determine the distance between edge of contact and wire:

Position	MSR $\times 10^{-2}$ m	VSC div	TR=MSR+(VSCxLC) $\times 10^{-2}$ m
Rubber band (R_1) (edge of contact)			
Given wire(R_2)			

l = (R_1~ R_2) = -------------- $\times 10^{-2}$ m

CALCULATION:

Thickness of the thin wire $t = \dfrac{l\lambda}{2\beta}$ metre

RESULT:

Thickness of the given wire using air wedge method = _________________________ m.

Viva – voce

1.What is meant by interference of light?

2.Is there any loss of energy in interference phenomenon?

3. What are interference fringes?

4.What is the shape of fringes in wedge shaped film?

5. Explain the reason for colour formation in soap bubbles.

6.What is meant by superposition of waves?

7.What is meant by air wedge method?

8.What is meant by fringe width?

9. What are constructive and destructive interferences?

10.What is the application of air wedge experiment?

To find the least count of screw gauge:

One pitch scale division = 1 mm

Distance moved upon 5 rotations = 5 mm

$$\text{Pitch} = \frac{Distance\ moved}{No.of\ rotations}$$

$$= \frac{5mm}{5} = 1 \text{ mm}$$

Number of head scale divisions = 100

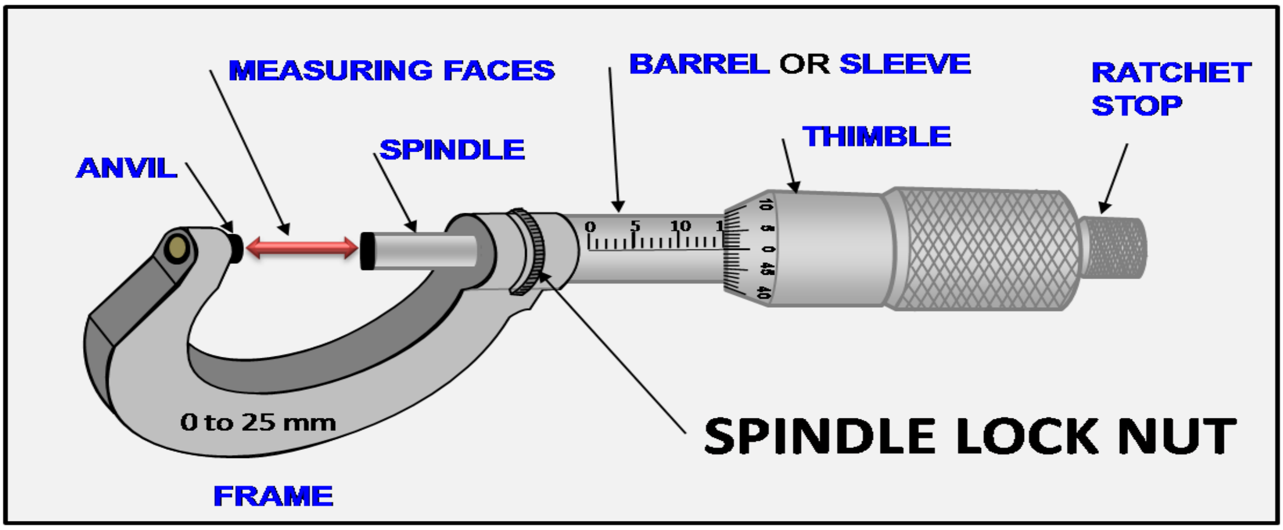
$$\text{Least count} = \frac{Pitch}{No.of HSD} = \frac{1mm}{100}$$

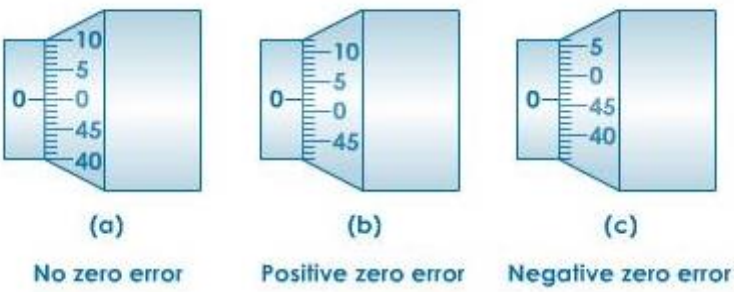
$$= 0.01 \text{ mm}$$

Least Count = 0.01×10^{-3} m

Screw gauge Diagram:

\





Expt. No.M1 **SCREW GAUGE**

AIM:

To determine the diameter of the given thin wire using Screw gauge

APPARATUS REQUIRED:

Screw gauge and thin wire

DESCRIPTION:

The screw gauge consists of a U – shaped metallic frame having a stud A at one end and a screw B passing through the other end. A scale graduated in millimeter called pitch scale is engraved on the screw. The head of the screw is divided into 100 divisions and this is called head scale. When the head of the screw is rotated, the head scale moves on the pitch scale and the tip of the screw moves through the frame towards the stud A.

PROCEDURE:

1. **To find least count:**

   Least count is defined as the least measurement of the instrument.

2. **To find errors:**

   The head is rotated till the tip of the screw just touches the stud A. If the zero of the head scale just coincides with the zero of the pitch scale and also lies on the base line of the pitch scale, then there is no error.

Positive error: If zero of the head scale lies below the base line of the pitch scale, then the error is positive and the correction is negative. The head scale division coinciding with the base line is noted. This reading when multiplied with least count gives the positive error.

To find the thickness of the wire:

Least Count = ……….mm zero error (ZE) = …… div.

= ……….10^{-3} m zero correction (ZC) = $\pm$ ZE × LC = ……..10^{-3} m

Sl. No.	Pitch Scale Reading (PSR) (× 10^{-3} m)	Head Scale Coincidence (HSC) (div.)	Observed thickness OT = PSR + (HSC × LC) (× 10^{-3} m)	Corrected Thickness CT = OT $\pm$ ZC (× 10^{-3} m)

Average diameter, d = ……………× 10^{-3} m

Negative error: If zero of the head scale lies above the base line, then the error is negative and the correction is positive. The head scale division coinciding with the base line is noted. This reading is subtracted from 100 and then multiplied with least count. This gives the negative error.

To find the thickness of the wire:

The given wire is gently gripped between the stud and the tip of the screw gauge. The pitch scale reading (PSR) and the head scale coincidence (HSC) are noted. The observed thickness of the wire is given by the following equation.

Observed thickness of the wire (OT) = PSR + (HSC × LC)

The observed thickness of the wire is corrected as follows,

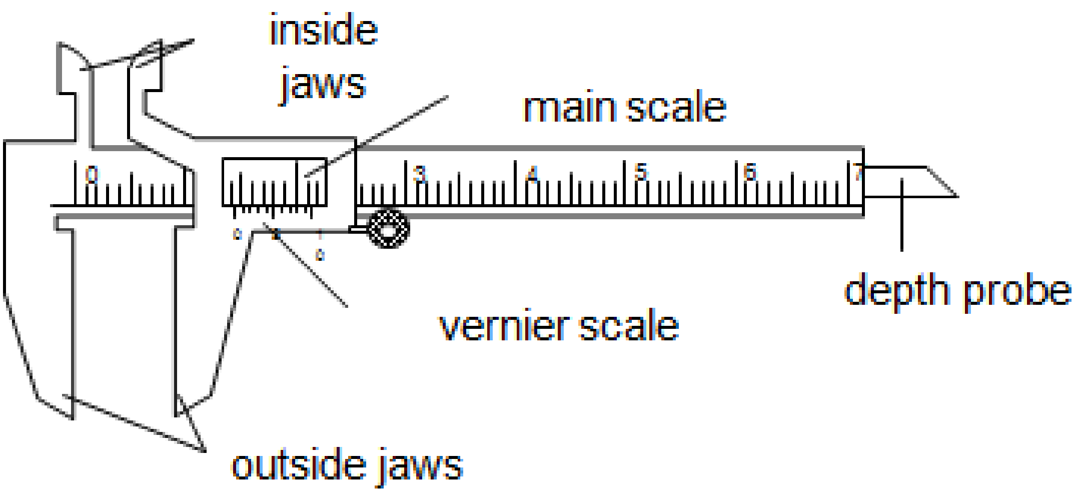
Corrected thickness of the wire (CT) = OT $\pm$ ZC

Observations are repeated by placing the screw gauge at various places of the wire. Readings are tabulated and the average thickness of the wire is calculated.

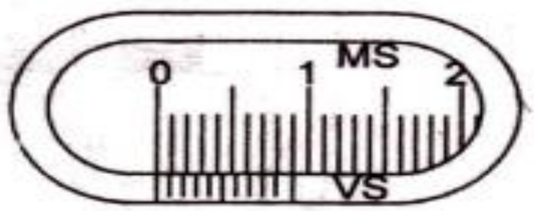
RESULT:

Thickness of the given thin wire, t = -------------------------------- mm

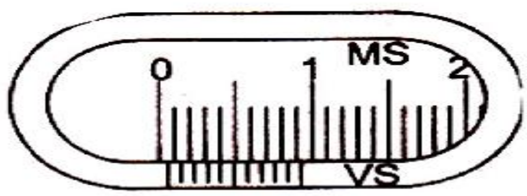
= ---------------------------------x10^{-3}m



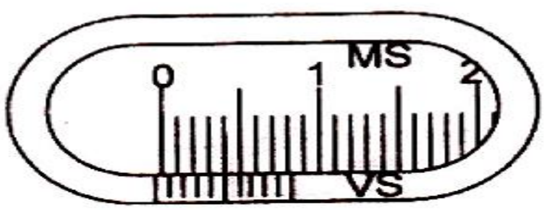
Vernier calipers



No error



Positive error



Negative error

Expt. No.M2 **VERNIER CALIPERS**

AIM:

To determine the breath of the given beam using vernier calipers

APPARATUS REQUIRED:

Vernier calipers and given beam

DESCRIPTION:

Vernier calipers consist of a long steel plate. One edge of the plate is graduated in centimeter and the other edge in inch. This is called main scale. Each centimeter is divided into 10 divisions and hence one main scale division is equal to 1 mm.

A fixed jaw A is attached to one end of the plate. Another movable jaw B can slide freely on the plate. An auxiliary scale called vernier scale is attached to this jaw B. The vernier scale is divided into 10 divisions.

PROCEDURE:

1. To find least count of vernier calipers:

Least count is the smallest measurement of the instrument.

1 MSD = 1 mm

10 VSD = 9 MSD

= 9 mm

1 VSD = 0.9 mm

Least count = 1 MSD — 1 VSD

= 1 mm — 0.9 mm = 0.1 mm

= 0.01 cm

Least count = 0.01×10^{-2} m

To find the breadth of the beam:

Least Count = ...cm

= ....10^{-2} m

zero error (ZE) = ... div.

zero correction (ZC) = $\pm$ ZE × LC

Sl. No.	Main Scale Reading (MSR) (× 10^{-2} m)	Vernier Scale Coincidence (VSC) (div.)	Observed breadth OT = MSR + (VSC × LC) (× 10^{-2} m)	Corrected Thickness CT = OB $\pm$ ZC (× 10^{-2} m)

Mean breadth = ...10^{-2}m

2. To find errors:

The two jaws of the vernier calipers are pressed together without any material in between them. If zero of the vernier scale coincides with the zero of the main scale, then the instrument has no error.

Positive error: If zero of the vernier scale is to the right of the zero of the main scale, then the error is positive and the correction is negative. The vernier scale division coinciding with any main scale division is noted. This vernier scale division multiplied with least count gives the positive error.

Negative error: If zero of the vernier scale is to the left of the zero of the main scale, then the error is negative and the correction is positive. The vernier scale division coinciding with any main scale division is noted. This vernier scale division multiplied with least count gives the negative error.

3. To find the breadth of the given beam:

The given beam is gently gripped between the two jaws. The main scale division just before the zero of the vernier scale is noted as Main Scale Reading (MSR). The vernier scale division which coincides with any of the main scale division is noted as Vernier Scale Coincidence (VSC).

Observed breadth of the beam (OB) = MSR + (VSC × LC)

The observed breadth of the beam is corrected as follows,

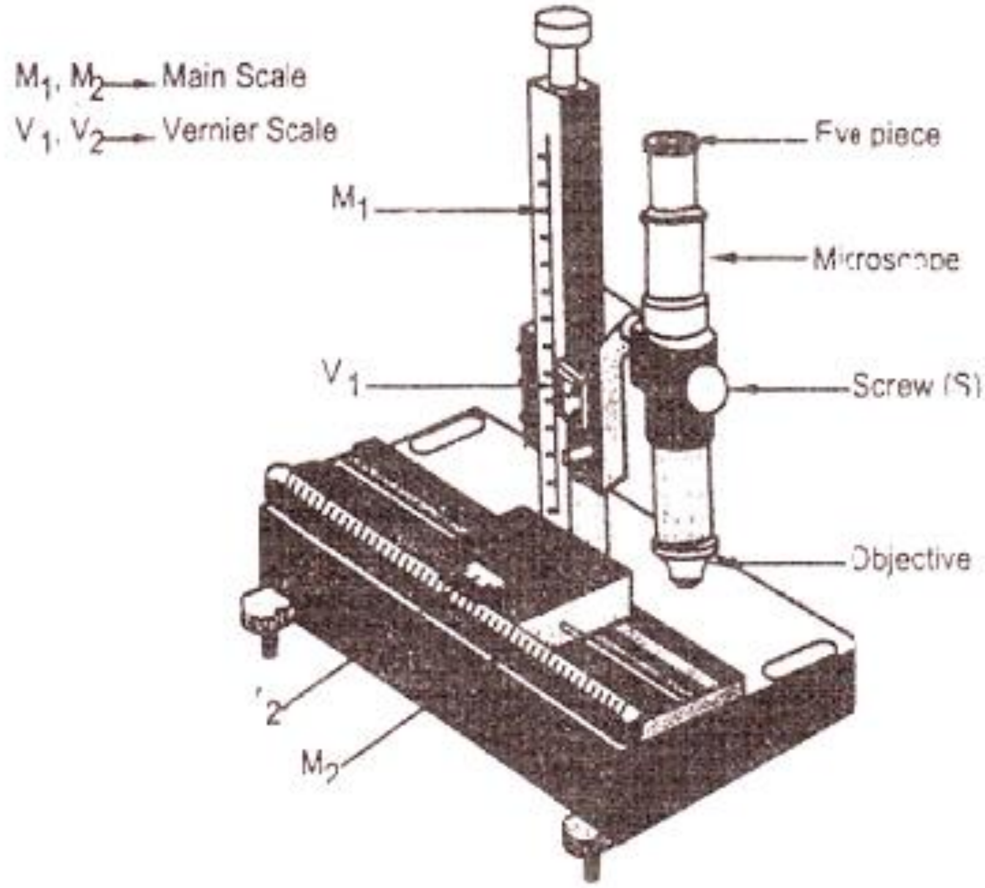
Corrected breadth of the beam (CB) = OB $\pm$ ZC

Observations are repeated by gripping the beam at various places. Readings are tabulated and the average breadth of the beam is calculated.

RESULT:

Breadth of the given beam = -------------------------------- cm

= ---------------------------------x10^{-2}m



To find the least count:

20 MSD = 10 mm

1 MSD = 0.5 mm

No. of vernier scale divisions = 50

1 VSD $= \frac{49MSD}{50} = \frac{49-0.5mm}{50}$

= 0.49 mm

Least Count= 1 MSD – 1 VSD

= 0.5 – 0.49

= 0.01 mm = 0.001 cm

Least Count = 0.001×10^{-2}m

Expt. No. M3 **TRAVELLING MICROSCOPE**

AIM:

To determine the diameter of the bore of the given capillary tube

APPARATUS REQUIRED:

Travelling microscope, capillary tube and reading lenses

DESCRIPTION:

Travelling microscope consists of a compound microscope. It can slide along a graduated vertical pillar, called vertical main scale. This vertical pillar can slide along a graduated horizontal base, called horizontal main scale. Hence the microscope can be moved both in the horizontal and vertical directions.

There are two verniers, one attached to the microscope is moved vertically and the other attached to the base of the pillar is moved horizontally.

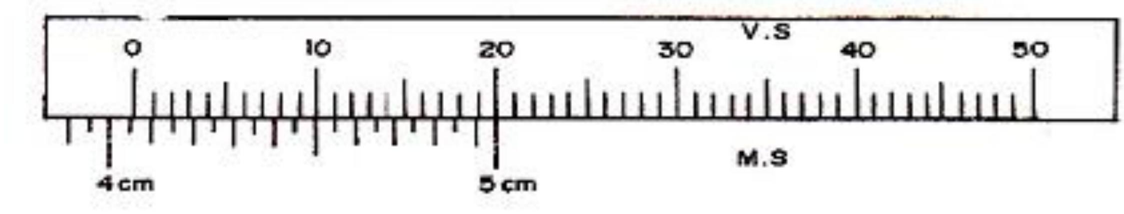
In the main scale, each one is divided into 20 equal divisions. Hence the value of the one main scale division is 0.5 mm. The vernier scale is divided into 50 equal divisions.

Focusing can be done using the screw provided in the microscope.

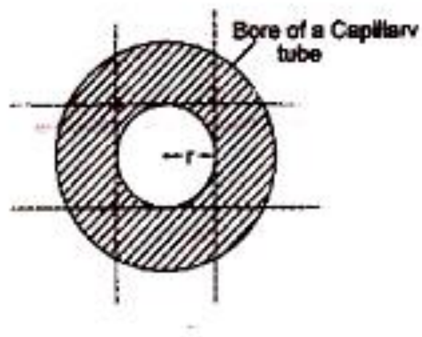
PROCEDURE:

To find the diameter of the bore of the capillary tube:

The given capillary tube is held horizontally with the help of a stand. The microscope is focused on to the bore of the capillary. The vertical crosswire of the microscope is adjusted to be tangential with the left side of the bore. The main scale reading and vernier scale coincidence are noted. Then the observed reading is calculated as follows.



Main scale and Vernier scale



To find the diameter of the bore of the Capillary tube:

Least Count = ……cm = …… x 10^{-2}m

Scale	Reading at one edge (R_1) (x 10^{-2}m)			Reading at the other edge (R_2) (x 10^{-2}m)			Diameter (R_1- R_2) (x 10^{-2}m)
	MSR	VSC	(OR) = MSR + (VSC × LC)	MSR	VSC	(OR) = MSR + (VSC × LC)	
Horizontal							
Vertical							

Mean diameter = ……………x 10^{-2}m

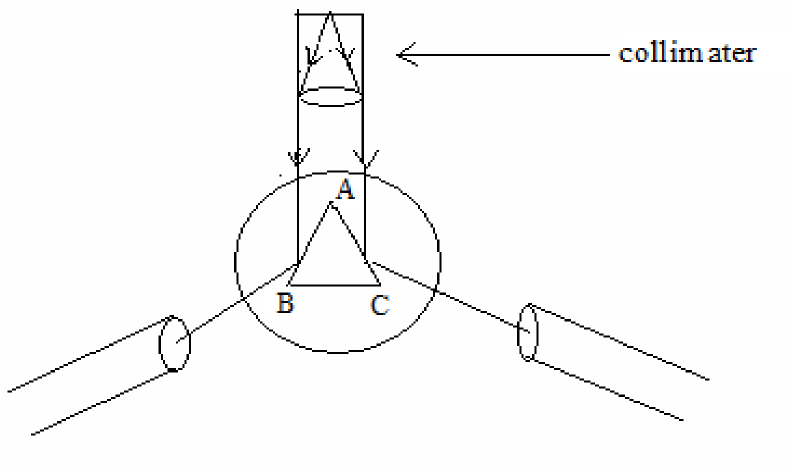
Observed reading (OR) = MSR + (VSC × LC)

Now vertical crosswire is adjusted to be tangential with the right side of the bore. The main scale reading and vernier scale coincidence are noted. The CR value is calculated. From the two ORs, the horizontal diameter of the bore is determined. Similarly, vertical diameter is also determined using horizontal crosswire.

RESULT:

The mean diameter of the bore of the given capillary tube = ---------------------- cm

= ---------------------- $\times 10^{-2}$ m



Spectrometer

Expt. No. M4 **SPECTRO METER**

AIM:

To study the different parts of the spectrometer and their functions

APPARATUS:

Spectrometer and reading lens

DESCRIPTION:

The collimator consists of two brass tubes, one sliding into the other with the help of a slide screw. At the outer end of the inner tube, an adjustable slit is attached. At the outer end of the outer tube, a collimating lens is fitted. When the slit is illuminated with the source of light, parallel beam of light is obtained by adjusting the screw attached to the collimator. The collimator is rigidly attached to the base of the spectrometer.

The telescope consists of an objective lens near the collimator and an eyepiece at the end of the telescope. Focusing is done with the help of a slide screw. Telescope can be rotated about the central vertical axis. It can be fixed at any position with the help of the main screw. The fine adjustments are done with the help of tangential screw.

The prism table consists of two identical circular discs provided with three leveling screws. The prism table is made horizontal with the help of leveling screws. The prism table can be raised or lowered and can be fixed at any height with the help of a screw. The prism table is capable of rotating about the same central vertical axis.

A circular scale is provided with the spectrometer. The circular scale is graduated in degree. Two vernier scales, 180^{o} apart are fitted to a separate circular plate. This circular plate is attached with the telescope.

PRELIMINARY ADJUSTMENTS:

Before commencing the experiment, the following preliminary adjustments of the spectrometer should be done.

1. The telescope of the spectrometer is turned towards a white wall and on seeing through it., the eyepiece is moved to and fro until crosswire is seen clearly.

Least count: 1'

Reading	Vernier A			Vernier B		
	MSR (deg)	VSC (div)	TR = MSR + (VSC × LC) (deg)	MSR (deg)	VSC (div)	(TR) = MSR + (VSC × LC) (deg)
Reflected ray						

Least Count for Spectrometer (LC = 1')

Value of 1 M.S.D =1/2 degree

Number of division on the vernier scale =30 division

Since 29 M.S.D are divided into 30 V.S.D

30 VSD = 29 MSD

$$1\text{VSD} = \frac{29}{30}\ 1\text{MSD}$$

$$= \frac{29}{30}\ \frac{1}{2}\ \text{degree}$$

$$= \frac{29}{60}\ \text{degree}$$

Least count = 1 MSD - 1 VSD

$$= \frac{1}{2} - \frac{29}{60}$$

$$\text{LC} = \left(\frac{1}{60}\right)^{o}\ (or)\ 1\ minutes\ (or)\ 1'$$

2. The telescope is focused on to a distant object. On viewing through, the side screw is adjusted to obtain clear well-defined image of the distant object. Now the telescope is ready to receive parallel rays.

3. The telescope is brought in line with the collimator. On seeing through telescope and collimator, the silt is adjusted to be vertical and thin.

4. Now the collimator is adjusted to obtain a well-defined image of the slit without disturbing the telescope.

5. The prism table is adjusted to be horizontal with the help of spirit level.

After the preliminary adjustments are over, the least count is determined.

READINGS:

The slit of the spectrometer is illuminated with mercury vapor lamp. The prism table is adjusted such that the refracting edge is facing the collimator (base of the prism points towards us) .The telescope is moved towards the left to get the reflected image of the slit. The tangential screw in the telescope is adjusted so that the slit coincides with the vertical crosswire.

The main scale reading and the vernier scale coincidence are noted.

Main Scale Reading (MSR): It is the reading in the main scale, shown by zero of the vernier scale.

Vernier Scale Coincidence (VSC): It is the vernier scale division which coincides with any of the main scale division.

Using MSR and VSC, the total reading (TR) is calculated as follows.

$$TR = MSR + (VSC \times LC)$$

RESULT:

The different parts of the spectrometer and their functions are studied.

LIST OF PROJECTS

1. Simple electric motor
2. Bridge using pop sticks
3. Hydraulic lift
4. Hydraulic Crane
5. Simple Electromagnet
6. Fire alarm
7. Mosquito repellent
8. Battery car
9. Hydraulic room cleaner
10. Direct solar pool heater
11. Total Internal reflection Experiments
12. Musical instrument using PVC tube
13. Creating sound using heat
14. Rocket launcher
15. Magnetic levitation
16. Electromagnetic Crane
17. Solar cell
18. Periscope
19. Water level indicator
20. Simple propeller
21. Propeller display
22. Electromagnetic induction
23. The world first electric lamp
24. Power generation from speed break
25. Wind mill
26. Floating ball in air
27. Fuel cell
28. Home made air condition
29. Horror House
30. Water candle