SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM NAGAR, KATTANKULATHUR – 603 203

PHYSICS PRACTICALS MANUAL

1901108 - PHYSICS LABORATORY

(First semester B.E/B.Tech. students for the Academic Year 2022-2023)

Prepared by

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Department of Physics

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DEPARTMENT OF PHYSICS

Instructions to the students

The following instructions must be followed by the students in their laboratory classes.

1. Students are expected to be punctual to the lab classes. If they are late, they will be considered absent for that particular session.
2. Students should strictly maintain the dress code.
3. Students must bring their observation note, record note (completed with previous experiment) and the calculator to every lab class without fail.
4. Students are advised to come with full preparation for their lab sessions by
   (i) Reading the detailed procedure of the experiment from the laboratory manual.
   (ii) Completion of observation note book (i.e.) Aim, Apparatus required, Formula (with description), least count calculation, diagrams and the tabular column should be written in the observation note before entering into the laboratory.
5. Data entry in the observation note book must be by pen only.
6. Students must get attestations immediately for their observed readings.
7. Students should complete their calculations for their experiments and get it corrected on the same day of that experiment.
8. Students who miss observation, record note they have to do the experiment once again and get it corrected.
9. Class assessment marks for each experiment is based only on their performance in the laboratory.
10. Record note has to be completed then and there and get corrected when the students are coming for the next lab class.
11. Students must strictly maintain silence during lab classes.
12. If any of the students is absent for the lab class for genuine reasons, he/she will be permitted to do the experiment during the repetition class only.
13. Students are advised to perform their experiments utmost care.

CONTENTS

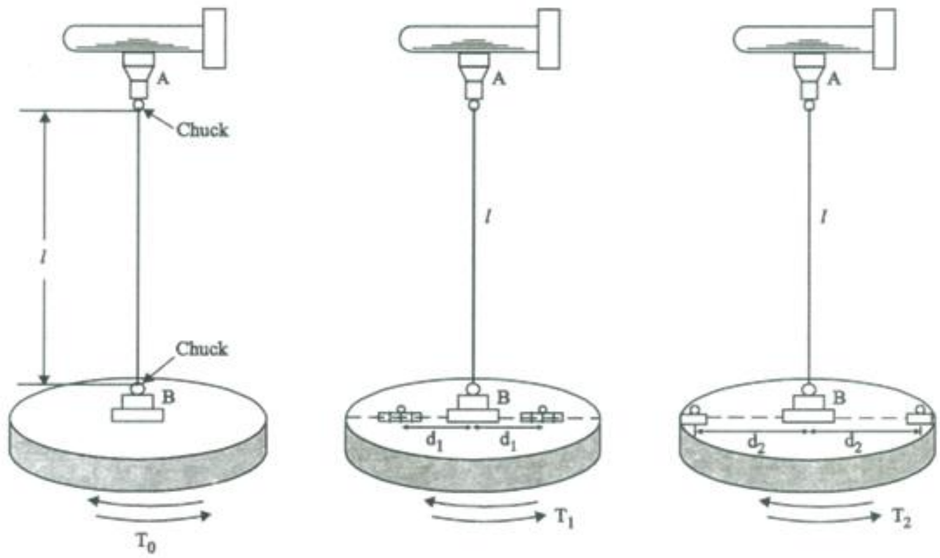


Fig.1.1. Torsional Pendulum

To find the time period of oscillations

Length of suspension wire ℓ = ……….cm

Position of equal masses	Time for 10 oscillations			Time period (mean/10)
	Trial 1	Trial 2	Mean	
Unit	second	second	second	second
Without masses				T_o =
Masses at closest distance. d_1 = ……… x 10^{-2} m				T_1 =
Masses at maximum distance. d_2 =……….x 10^{-2} m				T_2 =

DETERMINATION OF RIGIDITY MODULUS –TORSIONAL PENDULUM

AIM

To determine the moment of inertia of a given disc by Torsional oscillations and the rigidity modulus of the material of the suspension wire.

APPARATUS

Torsional pendulum, Stop clock, Meter scale, Two symmetrical mass and Screw gauge.

PRINCIPLE

The suspension wire is twisted by the circular disc fixed at the bottom of the wire and the wire undergoes shearing strain which leads to torsional oscillations. The angular acceleration of the disc is proportional to its angular displacement and is always directed towards its mean position and the motion of the disc is simple harmonic.

FORMULA

Moment of inertia of the circular disc,

$$I = \frac{2m\left(d_2^2 - d_1^2\right)T_0^2}{T_2^2 - T_1^2} \quad \text{kg.m}^2$$

Rigidity modulus of the wire,

$$n = \frac{8\pi I l}{T_0^2 r^4} \quad \text{N/ m}^2$$

Symbol	Explanation	unit
m	mass of one cylinder placed on the disc (200 gm)	kg
d_1	Closest distance (minimum) between suspension wire and the centre of mass of the cylinder	m
d_2	Farthest distance (maximum) between suspension wire and the centre of mass of the cylinder	m
T_0	Time period of oscillation without any mass on the disc	s
T_1	Time period of oscillation when equal masses are placed on the disc at a distance d_1	s
T_2	Time period of oscillation when equal masses are placed on the disc at a distance d_2	s
ℓ	length of the suspension wire	m
r	Radius of the wire	m

LEAST COUNT OF THE SCREW GAUGE:

$$\text{Pitch} = \frac{\text{Distance moved by the head scale on the pitch scale.}}{\text{Number of rotations given to the head scale.}}$$

$$\text{Least count (LC)} = \frac{\text{Pitch}}{\text{Total number of divisions on the head scale}}$$

Pitch = 5 mm/ 5 = 1 mm
LC = 1 mm/ 100 = 0.01 mm.

To find the radius (r) of the specimen using screw gauge

LC = 0.01 mm

Zero error = $\pm$ ....div.

Zero correction = $\mp$ ……..mm

S. No.	PSR	HSC	HSR= HSC x LC	Observed Reading = PSR + HSR	Correct Reading = OR + ZC
Unit	mm	div	mm	mm	mm

Mean (d) =-------------------------- x 10^{-3} m

Radius of the specimen wire (r) = d/2 = ……. x 10^{-3} m

PROCEDURE

- The Torsional pendulum consists of a circular disc suspended by a thin suspended wire, as shown in Fig. (1.1), whose rigidity modulus is to be noted. The top end of the wire is fixed by a chuck. The circular disc is attached to the other end of the wire.

- When the suspension wire is twisted by the circular disc fixed at the bottom of the wire, the wire undergoes shearing strain. This is called torsion. Because of this torsion, the disc executes oscillation called torsional oscillation.

Calculation of T_0

- Adjust the wire so that its length is fixed value say 50 cm. Make a vertical chalk mark on the disc when it is rest as a reference. By making a small twist to the circular disc, set up Torsional oscillations. After the first few oscillations, just as the mark on the disc passes the equilibrium positions, a stop clock is started. The time taken for 10 complete oscillations is noted. The experiments are repeated for second trial and mean value is calculated. The value of the time period is noted as T_0.

Calculation of T_1

- The two identical cylindrical masses are placed at equal distance on either side of the central chuck as close as possible. The distance d_1 is measured between the wire and the centre of the cylindrical mass. By twisting the disc, the time taken for 10 complete oscillations is noted. The experiments are repeated for second trial and mean value is calculated. The value of the time period is noted as T_1.

Calculation of T_2

- The identical masses are arranged symmetrically as far away from the axis of the rotation as possible. The distance d_2 is measured between the wire and the centre of the cylindrical mass of the time taken for 10 complete oscillations is noted. The experiments are repeated for second trial and mean value is calculated. The value of the time period is noted as T_2.

Calculation of Moment of Inertia and Rigidity Modulus

- The mean value of the radius and length of the wire is measured accurately by a screw gauge and meter scale respectively. The moment of the inertia of the circular disc and the rigidity modulus of the suspension wire are calculated by substituting the values in the equations respectively.

- Moment of Inertia can also be determined theoretically $I = MR^2/2$, where M= Mass of the Disc, R= radius of the Disc.

L

CALCULATION

Mean radius of the wire r = ...m

Length of the wire ℓ = ... m

Mass of the identical cylinder m = ... kg

Closest distance between suspension wire & the centre of symmetrical mass d_1 =..........m

Farthest distance between suspension wire& the centre of symmetrical mass d_2 =.........m

Period of oscillations (without masses) T_0 =............ sec

Period of oscillations with masses at 'd_1' distance T_1 = ...sec

Period of oscillations with masses at 'd_2' distance T_2 =...............sec

The moment of inertia of the circular disc,

$$I = \frac{2m\left(d_2^2 - d_1^2\right)T_0^2}{T_2^2 - T_1^2} \text{ kg.m}^2$$

I =..............................kg.m^2

Rigidity modulus of the wire,

$$n = \frac{8\pi I l}{T_0^2 r^4} \text{ N/ m}^2$$

n = ...N/m^2

RESULT

(i) Moment of inertia of the circular disc I = ________ kg m²

(ii) Rigidity modulus of the given wire n = ______ N/m^2

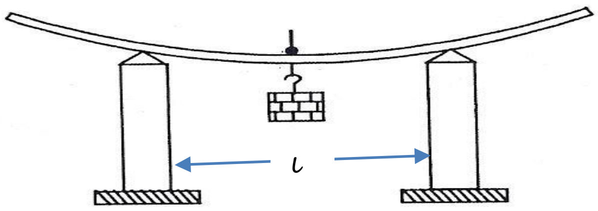


Figure 2.1 Young's modulus of the material by Non-uniform bending

DETERMINATION OF LEAST COUNT OF TRAVELLING MICROSCOPE

Least count = 1 MSD – 1 VSD

20 MSD = 1 cm

Value of 1 MSD = $\frac{1}{20}$ cm = 0.05 cm

Number of Vernier Scale Division = 50

50 VSD = 49 MSD

1 VSD = $\frac{49}{50}$ MSD = $\frac{49}{50}$ x 0.05 = 0.049

LC = 0.05 – 0.049 = 0.001 cm

LC = 0.001 cm

To find depression 'y'

Distance between two knife edges (*l*) = _____ x 10^{-2} m

TR = MSR + (VSC x LC) L.C = 0.001 cm

M = -------------------- x 10^{-3} kg

S. No.	Load	Microscope Readings						Mean	Depression y for 'M' in kg
		Loading			Unloading				
		MSR	VSC	TR	MSR	VSC	TR		
Unit	10^{-3} kg	cm	div	cm	cm	div	cm	cm	cm
1	W								
2	W+50								
3	W+100								
4	W+150								
5	W+200								
							Mean (y) = ------- x 10^{-2} m		

R

2. YOUNG'S MODULUS OF THE MATERIAL – NON-UNIFORM BENDING

AIM

To determine the Young's modulus of the material of a uniform bar by non -uniform bending method.

APPARATUS REQUIRED

Traveling microscope, Weight hanger with slotted weights, two knife edges, Pin, Wooden bar, Vernier caliper and Screw gauge.

PRINCIPLE

When a beam symmetrically supported on two knife edge is loaded at its centre, the bent beam would not form an arc of circle. This type of bending is called non uniform bending. The maximum depression is produced at its midpoint.

FORMULA

The Young's Modulus of the beam,

$$E = \frac{Mgl^3}{4bd^3y} \quad N/m^2$$

Symbol	Explanation	Unit
M	Load applied	kg
l	Distance between the two knife edges	m
b	Breadth of the beam (meter scale)	m
d	Thickness of the beam (meter scale)	m
y	Depression produced for 'M' kg of load	m
g	Acceleration due to gravity	ms^{-2}

L

To find the thickness (d) of the beam using screw gauge

LC = 0.01 mm

Zero error = ± ....div.

Zero correction = ∓ ……..mm

S. No.	PSR	HSC	HSR = HSC x LC	Observed Reading = PSR +HSR	Correct Reading = OR + ZC
Unit	mm	div	mm	mm	mm

Mean (d) = ------------------------- x10^{-3} m

To find the breadth (b) of the beam using Vernier Calipers

LC = 0.01 cm

Zero error = ± ....div.

Zero correction = ∓ ……..mm

S. No.	MSR	VSC	VSR = VSC x LC	Observed Reading = MSR +VSR	Correct Reading = OR +ZC
Unit	cm	div	cm	cm	cm

Mean (b) =-------------------------- x10^{-2} m

PROCEDURE

The weight of the hanger is taken as the dead load '**W**'. The wooden bar is brought to elastic mood by loading and unloading it, a number of times with slotted weights. With the dead load **W** suspended from the midpoint, the microscope is adjusted such that the horizontal cross-wire coincides with the image of the tip of the pin. The reading in the vertical scale is taken.

The experiment is repeated by adding weights in steps of 50 gm each. Every time the microscope is adjusted and the vertical scale reading is taken. Then the load is decreased in the same steps and the readings are taken. From the readings, the mean depression of the mid-point for a given load can be found. The length of the wooden bar between the knife edges is measured (ℓ).

The wooden bar is removed and its mean breadth 'b' and mean thickness 'd' are determined with a Vernier caliper and a screw gauge respectively.

From the observations, Young modulus of the material of the beam is calculated by using the given formula.

CALCULATION

Acceleration due to gravity	g =	9.8	ms^{-2}
Distance between the two knife edges	ℓ =	……….	m
Breadth of the beam	b =	…………	m
Thickness of the beam	d =	…………..	m
Depression produced for 'M' kg of load	y =	…………..	m
Load to calculate depression	M =	…………..	kg

The Young's modulus of the given material of the beam

$$E = \frac{Mgl^3}{4bd^3y} \quad N/m^2$$

RESULT

The Young's Modulus of the given beam

E = …………… N/m^2

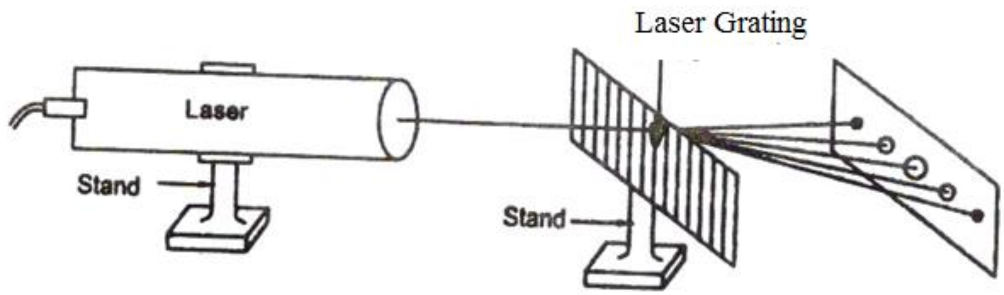


Figure 3.1 Laser Grating Experiment

Determination of wavelength of laser

Distance between the grating and the screen (D) = …….cm

Number of lines in grating per metre (N) = 1 x 10^5 lines / metre

S.No	Order of diffraction **n**	Readings of the diffracted image					$\lambda = \frac{\sin\theta}{nN}$
		Distance of different Orders from the central spot		Mean $x = \frac{x_L + x_R}{2}$	$\tan\theta = \left(\frac{x}{D}\right)$	$\theta = \tan^{-1}\left(\frac{x}{D}\right)$	
		Left side x_L	Right side x_R				
Unit		cm	cm	cm			m
1	1	x_1 =	x_1 =				
2	2	x_2 =	x_2 =				
3	3	x_3 =	x_3 =				
4	4	x_4 =	x_4=				

R

3. (a1) DETERMINATION OF WAVELENGTH AND PARTICLE SIZE USING LASER

AIM:

To determine the wavelength of the given laser using grating.

APPARATUS REQUIRED

Diode laser, grating, screen and scale.

PRINCIPLE

The laser light is exposed to the grating and diffraction takes place.

FORMULA

(1) Wavelength of the given laser

$$\lambda = \frac{\sin\theta}{nN} \ \textit{meter}$$

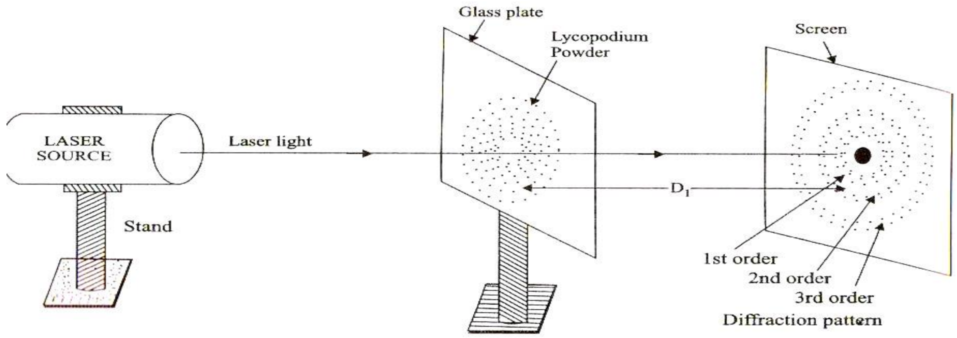
Symbol	Explanation	Unit
θ	Angle of diffraction	degree
n	Order of diffraction	-
N	Number of lines per meter in the grating	lines/m

PROCEDURE:

Diode laser is kept horizontally and switched on (care should be taken). The grating is held normal to the laser beam. This is done by adjusting the grating in such a way that the reflected laser beam coincides with the beam coming out of the laser. As shown in the Fig.3.1 After adjusting for normal incidence, the laser light is exposed to the grating and it is diffracted by it. On the other side of the grating on the screen, the diffracted laser spots are seen. The distances of different orders from the center spot (x) are measured. The distance between the grating and screen (D) is measured. Using the formula 'θ' is calculated. The wavelength of the laser light source is calculated using the given formula.

$$\lambda = \frac{\sin\theta}{Nn} \ \text{metre}$$

The number of lines in the grating is assumed as ≈ 1×10^5 lines per metre.



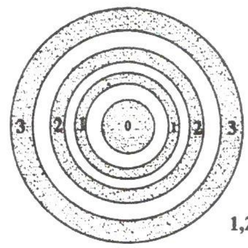


Figure 3.2. Particle size determination by Laser

Particle size determination

S.No	Distance between screen and glass plate (D)	Order of diffraction n	Distance between the central bright point and n^{th} fringe x_n	Particle Size $d = \frac{n\lambda D}{Xn}$
Unit	cm		cm	m
1		1		
		2		
2		1		
		2		
			Mean **d** =……………. m	

(a2) PARTICLE SIZE DETERMINATION USING LASER

AIM

To determine the size of the given micro particles (Lycopodium powder) using laser.

APPARATUS REQUIRED

Diode laser, fine micro particles having nearly same size, glass plate, screen, metre scale, etc.

FORMULA

Particle size (diameter) d is given by

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

Symbol	Explanation	Units
n	Order of diffraction	-
λ	Wavelength of laser light used	metre
D	Distance between glass plate and the screen.	metre
x_n	Distance between central bright spot and the n^{th} ring	metre

PROCEDURE

A glass plate is taken and a fine powder of particle size in the range of micrometer is sprinkled on the glass plate. This glass plate is kept between laser light and screen. The experimental is shown in the Fig.3.2. Now laser beam gets diffracted by the particles present in the glass plate. By adjusting the distance between the glass plate and the screen, (D) a circular fringe pattern is seen on the screen and the distance between the central bright point and n^{th} fringe x_n for various orders of diffraction is measured.

Using the formula, the particle size is determined. The experiment is repeated for different D values.

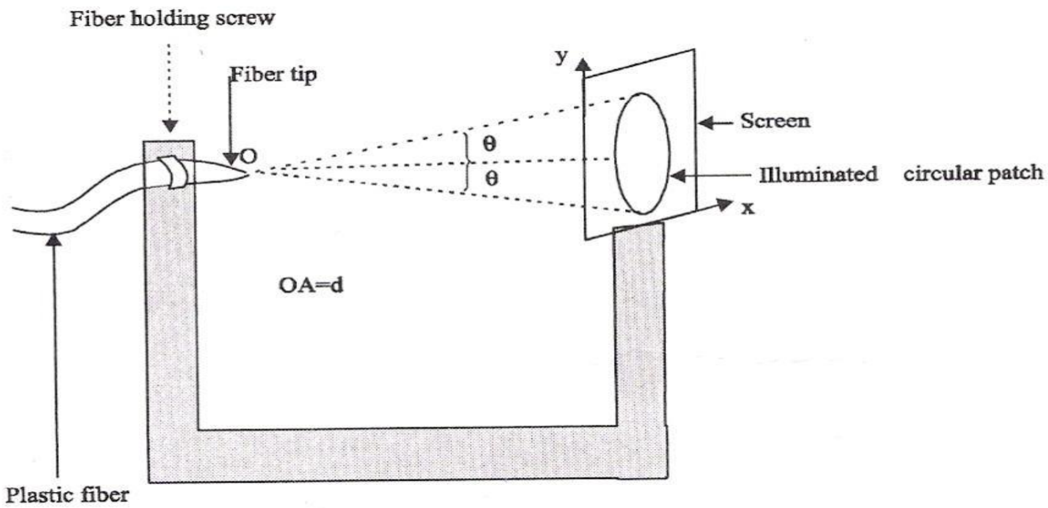


Figure 3.3. Experimental setup for acceptance angle

To determine acceptance angle

S.No	Distance from the fiber end to circular image 'd'	Radius of the circular image 'r'	Acceptance angle $\theta_a = \frac{r}{d} \times \frac{180}{\pi}$
Unit	$x10^{-2}$ m	$x10^{-3}$ m	Degree
1			
2			
3			
4			

(b) DETERMINATION OF ACCEPTANCE ANGLE IN AN OPTICAL FIBRE

AIM

To determine acceptance angle of an optical fiber.

APPARATUS REQUIRED

Laser for optical fiber light source, optical fiber, optical fiber connectors and Numerical aperture Jig.

PRINCIPLE

The principle behind the transmission of light waves in an optical fiber is total internal reflection.

FORMULA

$$\text{Acceptance angle} \quad \theta_a = \frac{r}{d} \times \frac{180}{\pi} \text{ degree}$$

Symbol	Explanation	Unit
r	Radius of the circular image	metre
d	Distance from fibre end to circular image	metre

PROCEDURE

Using laser, we can find the acceptance angle of the fiber optic cable. The given laser source is connected to the optical fiber cable. The other end is exposed to the air medium in the dark place. The emerging light is exposed on a plain paper.

Now, we get illuminated circular patch on the screen.Fig.3.3 shows the experimental setup for acceptance angle measure. The distance from the fiber end to circular image (d) is measured using meter scale. The radius of the circular image is also measured. Thus the acceptance angle is calculated

CALCULATION

(i) Wavelength of the laser source,

$$\lambda = \frac{\sin\theta}{nN} \text{ metre}$$

(ii) The size of the particle,

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

(iii) Acceptance angle,

$$\theta_a = \frac{r}{d} \times \frac{180}{\pi} \text{ deg}$$

RESULTS

a1) Wavelength of the given source λ = ------------------- metre.

a2) The size of the particle d = ___________ metre.

b) Acceptance angle of the fiber θ_a = ___________ degree.

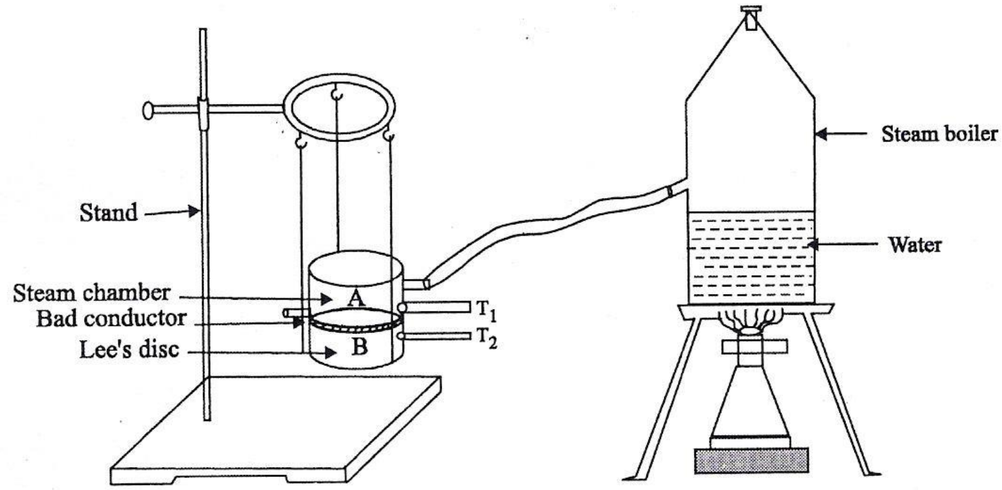


Figure 4.1. Lee's Disc arrangement

To measure the radius of the metallic disc (r)

LC= 0.01 cm

Zero error = ± ....div.

Zero correction = ∓ ……..cm.

S. No.	MSR	VSC	VSR = (VSC x LC)	Observed Reading = MSR +VSR	Correct Reading = OR +ZC
Unit	cm	div	cm	cm	cm

Mean diameter of the disc (D) = ……………………… x 10^{-2} m.

Mean radius of the disc (r) = (D/2) ………………………. x 10^{-2} m.

4. THERMAL CONDUCTIVITY OF A BAD CONDUCTOR - LEE'S DISC

AIM

To determine the thermal conductivity of a bad conductor using Lee's disc apparatus.

APPARATUS REQUIRED

Lee's disc apparatus, Bad conductors (card board, glass or ebonite), Thermometers, Stop-Clock, Steam boiler, screw gauge, vernier calipers.

PRINCIPLE

At the steady state rate of heat flowing into a system is equal to rate of heat flowing out of a system. Here the rate of heat conducted by poor conductor to block below it is equated to rate of heat radiated by the Lee's disc.

FORMULA

Thermal conductivity of a bad conductor

$$K = \left[\frac{MSd}{\pi r^2}\right] \times \left[\frac{r+2h}{2r+2h}\right] \times \left[\frac{\left(d\theta/dt\right)_{\theta_2}}{\theta_1 - \theta_2}\right] \text{ watt metre}^{-1} \text{ kelvin}^{-1}$$

Symbol	Explanation	Unit
M	Mass of the metallic disc	kg
S	Specific heat capacity of the material of the disc	J kg K^{-1}
$\left(d\theta/dt\right)_{\theta_2}$	Rate of cooling at steady temperature θ_2	℃/s
θ_1	Steady temperature of a steam chamber	℃
θ_2	Steady temperature of the metallic disc	℃
r	Radius of the metallic disc	metre
h	Thickness of the metallic disc	metre
d	Thickness of the bad conductor	metre

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

LC= 0.01mm

Zero error = ± ....div.

Zero correction = ∓ ……..mm

S. No.	PSR	HSC	HSR=HSC x LC	Observed Reading = PSR + HSR	Correct Reading = OR +ZC
Unit	mm	div	mm	mm	mm

Mean thickness of the cardboard (d) =………………………….. X10^{-3} m

To find the thickness of the metallic disc (h)

LC= 0.01 mm

Zero error = ± ....div.

Zero correction = ± ……..mm

S. No.	PSR	HSC	HSR=HSC x LC	Observed Reading= PSR +HSR	Correct Reading = OR +ZC
Unit	mm	div	mm	mm	mm

Mean thickness of the metallic disc (h) =……………………….x 10^{-3} m

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 the metallic disc is also found by using a common balance. The readings are tabulated. The whole Lee's disc apparatus is suspended from a stand as shown in the fig.4.1. The given bad conductor (card board) is placed in between the metallic disc and the steam chamber. Two thermometers T1 and T2 are inserted in 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 temperatures of the steam chamber and 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 ^{0}C above θ_2 (Steady temperature of the disc), the steam chamber is carefully removed, after cutting off the steam supply.

When the temperature of the disc reaches 10 ^{0}C above the steady temperature of the disc. i.e $(\theta_2 + 10)$ ℃, a stop clock is started. Time for every 1℃ fall of temperature is noted until the metallic disc attains a temperature $(\theta_2 - 10)$ ℃

LEAST COUNT OF THE SCREW GAUGE:

$$\text{Pitch} = \frac{\text{Distance moved by the head scale on the pitch scale.}}{\text{Number of rotations given to the head scale.}}$$

$$\text{Least count (LC)} = \frac{\text{Pitch}}{\text{Total number of divisions on the head scale}}$$

Pitch = 5 mm/ 5 = 1 mm

LC = 1 mm/ 100 = 0.01 mm.

LEAST COUNT OF THE VERNIER CALIPER:

LC = 1MSD – 1VSD

Value of 1MSD = 1/10 cm = 0.1 cm

Number of divisions on the Vernier scale = 10 divisions

Since 9MSD are divided into 10 VSD

10 VSD = 9 MSD

1 VSD = 9/10 MSD

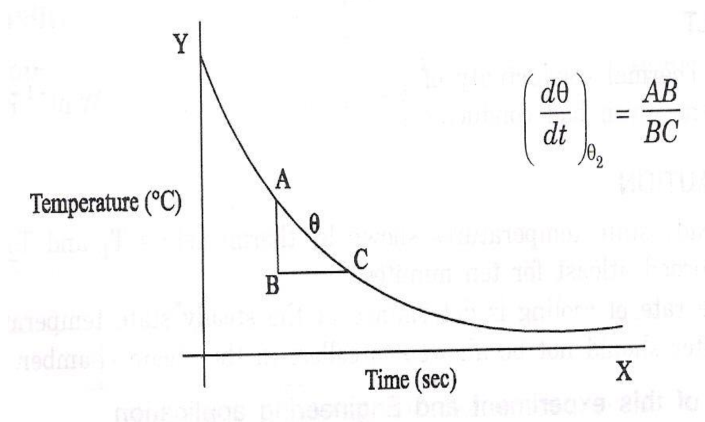
VSD = 9/10*1/10 = 9/100 cm

LC = 1/10 – 9/100

= (10-9)/100 = 1/100 cm

= 0.01 cm

To determine the Rate of cooling of the metallic disc $\left[\frac{d\theta}{dt}\right]_{\theta_2}$



Temperature (θ)	**Temperature (θ)**	**Time (t)**	**Temperature (θ)**	**Temperature (θ)**	**Time (t)**
°C	K	second	°C	K	second

R

CALCULATION

Mass of the metallic disc M =...........kg.

Specific heat capacity of the solid S = 370 J $kg^{-1}K^{-1}$.

Radius of the metallic disc r = ... x 10^{-2} metre

Thickness of the metallic disc h = ...x 10^{-3}metre.

Thickness of the cardboard d = ... x 10^{-3} metre.

Steady state temperature of steam chamber θ_1 = ...°C

Steady state temperature of disc θ_2 = ... °C

Rate of cooling $\left(\frac{d\theta}{dt}\right)_{\theta_2}$ at steady state temperature (θ_2 °C) =..............°C/s

(from graph)

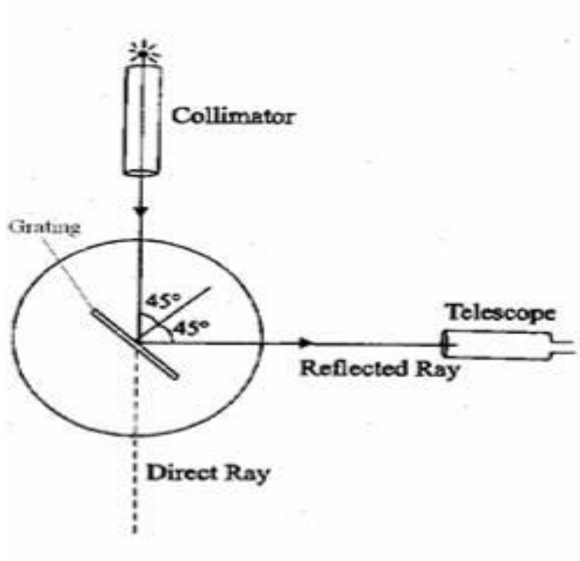
$$K = \left[\frac{MSd}{\pi r^2}\right] \times \left[\frac{r+2h}{2r+2h}\right] \times \frac{\left(d\theta/dt\right)_{\theta_2}}{\theta_1 - \theta_2} \text{ watt metre}^{-1} \text{ kelvin}^{-1}$$

K = -------------------------- W m^{-1} K^{-1}

RESULT

Thermal conductivity of the given bad conductor K = -------------------------- W m^{-1} K^{-1}

L



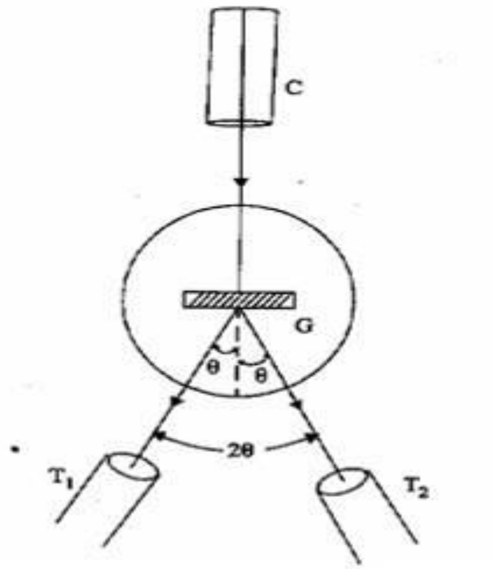


Figure 5.1.To set for normal incidence position

Figure 5.2. Diffracted ray from grating

DETERMINATION OF LEAST COUNT

2MSD = 1°

1MSD = 1/2° = 0.5° = 30′

LC = 1 MSD – 1 VSD

Number of divisions in vernier scale = 30

30 VSD = 29 MSD

1 VSD = 29/30 x MSD = 29/30′ x30′ =29′

LC = 30′ – 29′

LC = 1′ (One minute)

R

5. SPECTROMETER - DETERMINATION OF WAVELENGTH OF MERCURY SPECTRUM

AIM

To determine the wavelength of the mercury (Hg) spectrum using the plane transmission grating.

APPARATUS REQUIRED

Spectrometer, Sodium vapour lamp, Plane transmission grating, spirit level, Mercury vapour lamp, and reading lens.

PRINCIPLE

A plane sheet of transparent material on which a large number of equidistant opaque rulings are made with a diamond point forms grating. The space between the rulings and transparent area constitute a parallel slit. When light passes through such a grating, diffraction takes place. Angle of diffraction depends upon the wavelength of the light and number of lines per metre on the grating. So the number of lines per metre in grating and wavelength of the source can be calculated.

FORMULA

The wavelength of the spectral lines of mercury spectrum

$$\lambda = \frac{\sin\theta}{n\,N}\ \ metre$$

Symbol	Explanation	Unit
θ	Angle of diffraction	degree
N	Number of lines/ metre	lines/ metre
n	Order of spectrum	no unit

To determine the wavelength(λ) of the prominent lines of the mercury spectrum

Least count = 1'

N= ……………………………….lines/meter

Order of the spectrum n = 1

TR = MSR + (VSC x LC)

Spectral lines (colours)	Readings for diffracted image												Difference between Vernier A and Vernier B		Mean 2θ	Mean angle of diffraction θ	$\lambda = \frac{\sin\theta}{nN}$
	Left Side						Right side										
	Vernier A (A_1)			Vernier B (B_1)			Vernier A (A_2)			Vernier B (B_2)			$2\theta = A_1 \sim A_2$	$2\theta = B_1 \sim B_2$			
	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR					
	deg.	div.	deg.	deg.	div.	deg.	deg.	div.	deg.	deg.	div.	deg.	deg.	deg.	deg.	deg.	meter
Violet																	
Blue																	
Green																	
Yellow																	
Red																	

PROCEDURE

(i) **Normal Incidence**

Preliminary adjustments of the spectrometer are made. The grating is mounted on the grating table with its ruled surface facing the collimator the slit is illuminated by a source of light (sodium vapour lamp). The slit is made to coincide with the vertical cross wires. The vernier scales are adjusted to read 0˚ and 180˚ for the direct ray. The telescope is rotated through an angle of 90˚ and fixed. The grating table is adjusted until the image coincides with the vertical cross wire. Both the grating table and the telescope are fixed at this position as shown in Fig.5.1. Now rotate the vernier table through 45˚ in the same direction in which the telescope has been previously rotated. The light from the collimator incident normally on the grating. The telescope is released and is brought on the line with the direct image of the slit. Now the grating is said to be in normal incidence position

(iii) **Determination of Wavelength (λ) of the Source**

The sodium vapour lamp is replaced by mercury vapour lamp. The diffracted images of the first order are seen on either side of the central direct image as shown in Fig.3.2. The readings are tabulated by coincide the vertical cross wire with the first order on the either side of the central direct image prominent lines namely violet, blue, bluish green, green, yellow, red of the mercury spectrum. The difference between the readings give 2θ, from this θ can be found. The wavelength of each spectral line is calculated using the equation, $\lambda = \sin\theta / Nn$ metre.

L

CALCULATION

Order of the spectrum $n = 1$

1. The wavelength of the spectral lines of mercury spectrum,

$$\lambda = \frac{\sin\theta}{n\,N}\ \ metre$$

Wavelength for violet,

λ_v =……………….Å

Wavelength for blue

λ_B =……………….Å

Wavelength for green

λ_G=……………… Å

Wavelength for yellow

λ_Y=……………………….Å

Wavelength for red

λ_R =……………….Å

RESULT

(i) Wavelength of various spectral lines

S.No	Colour of the spectrum	wavelength Å
1	Violet	
2	Blue	
3	Green	
4	Yellow	
5	Red	

DATA OF PHYSICAL CONSTANTS & STANDARD VALUES

S.No.	Physical Constants	Symbol	Value in SI Unit
1	Velocity of light	c	3×10^{8} m/s
2	Acceleration due to gravity	g	9.8 m/s^{2}
3	Planck's constant	h	6.625×10^{-34} Js
4	Charge of an electron	e	1.69×10^{-19} C
5	Avogadro number	N_A	6.023×10^{26} atoms/ k mole
6	Boltzmann constant	k	1.38×10^{-23} J/K
7	Young's modulus of the wooden beam	E	1×10^{10} Nm^{-2}
8	Young's modulus of the teak wooden beam	E	1.7×10^{10} Nm^{-2}
9	Wavelength of sodium vapour lamp	λ	D_1 = 5890 Å, D_2 = 5896 Å
10	Wavelength of mercury vapour lamp	λ_v λ_B λ_G λ_{YI} λ_R	4047 Å 4358 Å 5461 Å 5770 Å 6234 Å

R

VIVA-VOCE QUESTIONS AND ANSWERS

RIGIDITY MODULUS- TORSIONAL PENDULUM

1. What is torsional pendulum?

A body suspended from a rigid support by mens of a long and thin elastic wire is called torsional pendulum.

2. **What is the type of oscillation?**

This is of simple harmonic oscillation type.

3. How will you determine the rigidity of fluids?

As fluids do not have a shape of their own, hence they do not posses rigidity. Hence there is no question of determining it.

YOUNGS MODULUS NON-UNIFORM BENDING

1. W**hat is young's modulus?**

Young's modulus is defined as the ratio of longitudinal stress to longitudinal strain.

2. What is a beam?

A beam is a rod or bar of uniform cross-section (circular or rectangular) whose length is very much greater than its thickness.

3. **How are longitudinal strain and stress produced in your experiment?**

Due to depression, the upper or the concave side of the beam becomes smaller than the lower or the convex side of the beam. As a result, longitudinal strain is produced. The change in wave length of the beam. These forces will give rise to longitudinal stress.

4. Which dimension- breath, thickness or length of the bar-should be measured very careful and why?

The thickness of the bar should be measured very carefully since its magnitude is small and it occurs in the expression 'E' in the power of three. An inaccuracy in the measurement of the thickness will produce the greatest proportional error in 'E'.

5. **Why do you place the beam symmetrically on the knife edges?**

To keep the reaction at the knife edges equal in conformity with the theory.

L

LASER PARAMETERS

1. What is meant by active material in laser?

The material in which the population inversion is achieved is called active material.

2. What is semi conductor diode laser?

Semiconductor diode laser is a specially fabricated pn junction diode. It emits laser light when it is forward biased**.**

3.. What are the characteristic of laser radiation?

Laser radiations have high intensity, high coherence, monochromatic and high directionality with less divergence.

4. What is stimulated emission?

The process of forced emission of photons caused by incident photons is called stimulated emission

5. Define acceptance angle

The maximum with which a ray of light can enter through one end of the fiber and still be totally internally reflected is called acceptance angle of the fiber.

6. What is the principle used in fiber optic communication system?

The principle behind the transmission of light waves in an optical fiber is total internal reflection.

7. **Define Numerical Aperature**

It is the light collecting efficiency of the fiber, It is a measure of the amount of light rays that can be accepted by the fiber .It is equal to the sine of the acceptance angle.

$$NA = \sin\theta = \sqrt{{n_1}^2 - {n_2}^2}$$

R

LEE'S DISC

1. What is thermal conductivity?

It is defined as the quantity of heat conducted per second normally across unit area of cross section of the material per unit temperature difference. It denotes the heat conducting power. Its unit is Watt meter^{-1} kelvin^{-1}

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

No, it depends only on the material of the specimen.

3. Can this method be used for good conductors?

No, in that case, due to large conduction of heat, the temperature recorded by θ_1 and θ_2 will be very nearly the same

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

A thin disc is taken because its area of cross section is large, while thickness is small. It increases the quantity of heat conducted across its faces.

5. What is meant by rate of cooling?

The rate at which temperature decreases with time(°C/min).

SPECTROMETER GRATING

1. What is the use of collimator and telescope?

A collimator is a device that narrows a beam of particles or waves. A telescope is an instrument that aids in the observation of remote objects by collecting electromagnetic radiation (such as visible light).

2. What is plane transmission diffraction grating?

A plane transmission diffraction grating is an optically plane parallel glass plate on which equidistant, extremely close grooves are made by ruling with a diamond point.

3. In our experiment. What class of diffraction does occur and how?

Fraunhofer class of diffraction occurs. Since the spectrometer is focused for parallel rays, the source and the image are effectively at infinite distances from the grating.

4. How are the commercial gratings are made?

L

A commercial grating is made by pouring properly diluted cellulose acetate on the actual grating and drying it to a thin strong film. The film is detached from the original grating and is mounted between two glass plates. A commercial grating is called replica grating. In our experiment we use plane type replica grating.