

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM NAGAR, KATTANKULATHUR – 603 203



PHYSICS PRACTICALS MANUAL

GE3121 - PHYSICS LABORATORY

(R-23)

(First semester B.E/B.Tech. students for the Academic Year 2025-2026)

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.

OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Calculation of lattice cell parameter – X-ray diffraction method.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
3. (a). Compact disc- Determination of width of the groove using Laser.
(b). Determination of particle size using Laser
4. (a) Determination of wavelength using Laser
(b) Determination of acceptance angle and numerical aperture in an optical fiber.
5. Determination of Planck's constant using LED.
6. Determination of thickness of a thin wire – Air wedge method
7. Determination of wavelength of mercury spectrum – spectrometer grating
8. Determination of rigidity modulus – Torsion pendulum
9. Determination of Young's modulus by non-uniform bending method.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyze laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

REFERENCE

1. Wilson J.D. and Hernaandez Hall C.A.,— Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, A Text Book of Practical Physics, S. Sultan Chand publications. 2005
3. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

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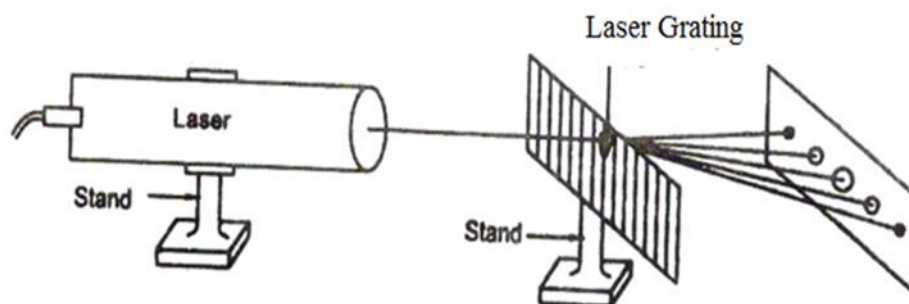


Fig. 1.1 Laser grating experiment

Determination of wavelength of laser

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

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

S.No	Order of diffraction n	Readings of the diffracted image					$\lambda = \frac{\sin \theta}{nN}$
		Distance of different Orders from the center 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 =				

Mean $\lambda = \text{----- m}$

1. (a) DETERMINATION OF WAVELENGTH USING LASER

AIM:

To determine the wavelength of the given laser light.

APPARATUS REQUIRED

Diode laser, grating, screen and scale.

PRINCIPLE

The laser light is exposed to the grating and diffraction occurs.

FORMULA

Wavelength of the given laser

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

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

PROCEDURE:

The laser source and the laser grating are mounted on separate stands as shown in Fig. 1.1. A fixed distance (D) is kept between the laser grating and the screen. The laser source is switched on, and the beam of laser beam is allowed to fall on the laser grating. The diffracted beams are collected on the screen. The diffracted beams appear as spots.

The first order is greater than the second order and so on. The positions $x_1, x_2, x_3, \dots$ of the spots belonging to the first order, second order, third order, etc on either side of the central maximum are marked on the screen and are noted. The wavelength of the laser source can be found using the below formula.

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

The number of lines in the grating is assumed as $\approx 1 \times 10^5$ lines per metre.

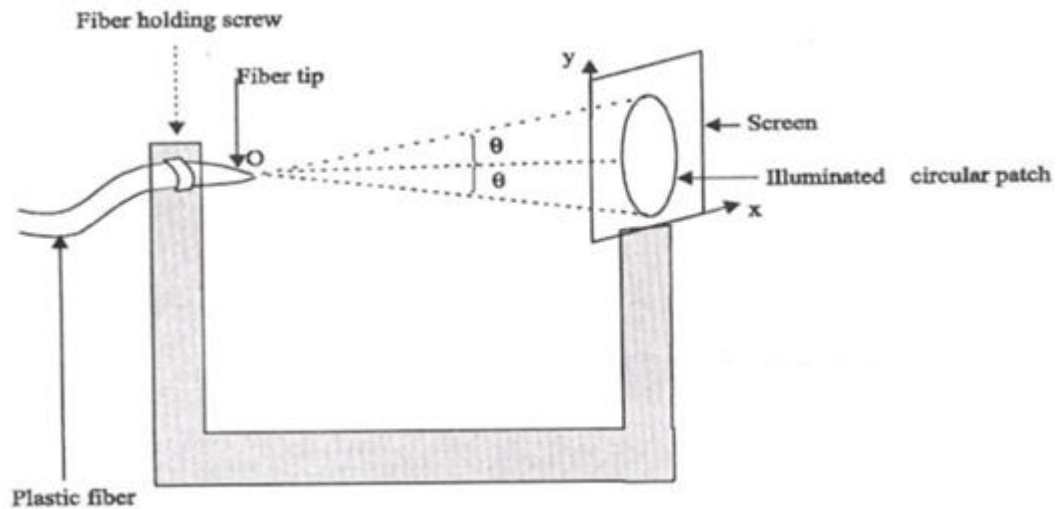


Fig. 1.2. Experimental setup for acceptance angle

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	cm	mm	deg
1			
2			
3			
4			

Mean $\theta_a =$

1. (b) DETERMINATION OF ACCEPTANCE ANGLE AND NUMERICAL APERTURE IN AN OPTICAL FIBRE

AIM

To determine acceptance angle and numerical aperture 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

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

$$\text{Numerical Aperture} = \text{NA} = \sin \theta_a$$

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.1.2 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 (r) of the circular image is also measured. Thus the acceptance angle is calculated.

CALCULATION

(a) Wavelength of the laser source,

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

(b) Acceptance angle,

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

$$\text{Numerical Aperture} = \text{NA} = \sin \theta_a$$

RESULTS

a) Wavelength of the given source $\lambda =$ ----- metre.

b) Acceptance angle $\theta_a =$ -----.

Numerical Aperture NA = -----

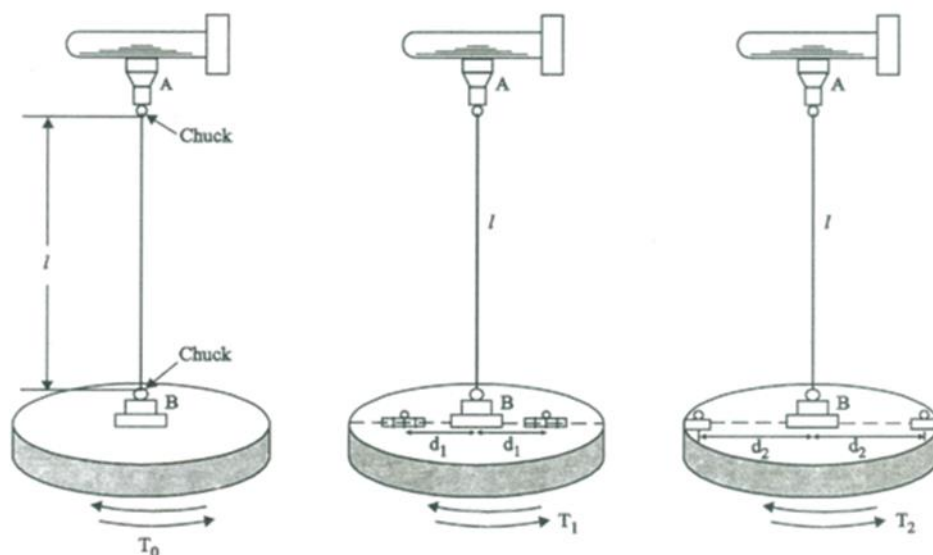


Fig.2.1. Torsional pendulum

To find the time period of oscillations

Length of suspension wire $\ell = \dots\dots\dots\text{cm}$

Position of equal masses	Time for 10 oscillations			Time period
	Trial 1	Trial 2	Mean	
Unit	second	second	second	second
Without masses				$T_0 =$
Masses at the closest distance. $d_1 = \dots\dots\dots \times 10^{-2} \text{ m}$				$T_1 =$
Masses at maximum distance. $d_2 = \dots\dots\dots \times 10^{-2} \text{ m}$				$T_2 =$

2. DETERMINATION OF RIGIDITY MODULUS –TORSION PENDULUM

AIM

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

APPARATUS REQUIRED

Torsional pendulum, Stop clock, Meter scale, Two symmetrical masses 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,

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

Rigidity modulus of the wire,

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

Symbol	Explanation	unit
m	Mass of one cylinder placed on the disc (200 gm)	kg
d ₁	Closest distance (minimum) between the suspension wire and the centre of mass of the cylinder	m
d ₂	Farthest distance (maximum) between the 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:

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

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

$$\text{Pitch} = 5 \text{ mm} / 5 = 1 \text{ mm}$$

$$\text{LC} = 1 \text{ mm} / 100 = 0.01 \text{ mm.}$$

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

$$\text{LC} = 0.01 \text{ mm}$$

$$\text{Zero error} = \pm \dots\dots\dots \text{div.}$$

$$\text{Zero correction} = \mp \dots\dots\dots \text{mm}$$

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

$$\text{Mean (d)} = \dots\dots\dots \times 10^{-3} \text{ m}$$

$$\text{Radius of the specimen wire (r)} = d/2 = \dots\dots\dots \times 10^{-3} \text{ m}$$

PROCEDURE

- A long uniform wire is clamped by a vertical chuck, and the other end is attached by another chuck.
- The suspension wire is fixed at 50 cm, and a slightly twisted disc is used to execute torsional oscillations.
- Time taken for 10 oscillations is noted using a pointer, and two trials are taken to determine the mean period (T_0).
- Two equal symmetrical masses are placed on the disc symmetrically, with the closest distance ' d_1 ' from the centre of the symmetrical mass and the centre of the suspension wire.
- The disc with masses at distance ' d_1 ' is allowed to execute torsional oscillations, and the mean period ' T_1 ' is determined.
- Two equal symmetrical masses are placed on the disc symmetrically, at the farthest distance ' d_2 ' from the centre of the symmetrical mass and the centre of the suspension wire.
- The disc with masses at distance ' d_2 ' is allowed to execute torsional oscillations, and the mean period ' T_2 ' is determined.
- The wire's diameter is measured using a screw gauge, and its radius(r) is calculated. The moment of inertia and the rigidity modulus are also calculated.

CALCULATION

Mean radius of the wire $r = \dots\dots\dots$ m

Length of the wire $\ell = \dots\dots\dots$ m

Mass of the identical cylinder $m = \dots\dots\dots$ kg

Closest distance between suspension wire & the centre of symmetrical mass $d_1 = \dots\dots\dots$ m

Farthest distance between suspension wire & the centre of symmetrical mass $d_2 = \dots\dots\dots$ m

Period of oscillations (without masses) $T_0 = \dots\dots\dots$ sec

Period of oscillations with masses at ' d_1 ' distance $T_1 = \dots\dots\dots$ sec

Period of oscillations with masses at ' d_2 ' distance $T_2 = \dots\dots\dots$ sec

The moment of inertia of the circular disc,

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

$$I = \dots\dots\dots \text{ kg m}^2$$

Rigidity modulus of the wire,

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

$$n = \text{.....N/m}^2$$

RESULT

(i) Moment of inertia of the circular disc $I = \text{..... kg m}^2$

(ii) Rigidity modulus of the given wire $n = \text{..... N/m}^2$

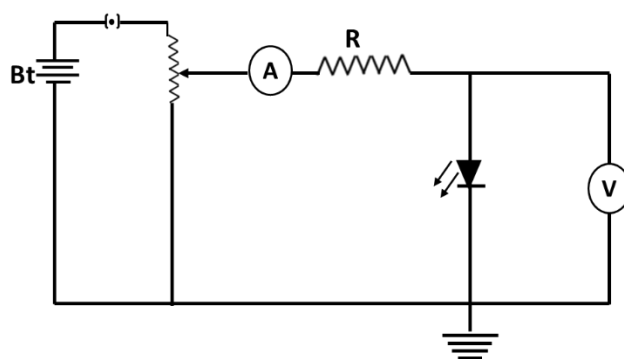


Fig.3.1. Circuit diagram for determination of Planck's constant

S.NO	Colour of LED	Wavelength (λ) nm	Knee voltage (V) volt	$h = \frac{e\lambda V}{c}$ Js
1.	Red	625		
2.	Yellow	586		
3.	Green	565		
4.	Blue	460		

3. DETERMINATION OF PLANCK'S CONSTANT USING LED

AIM

To determine the value of Planck's constant (h) by using LED

APPARATUS

Planck's constant kit, 0-3 V power supply, digital milli ammeter, digital voltmeter, 1K resistor and 4 different wavelength LEDs.

PRINCIPLE

When the p-n junction diode is forward biased, electrons and holes in an LED recombine at the depletion layer, releasing energy as light.

FORMULA

The Planck's constant

$$h = \frac{e\lambda V}{c} \quad \text{joule – second}$$

EXPLANATION

Symbol	Explanation	unit
h	Planck's constant	Js
e	Charge of an electron	C
V	Knee voltage	volt
c	Velocity of light	m/s
λ	Wavelength of LED	nm

PROCEDURE

- Connections are made as shown in the circuit diagram. (Fig.3.1). The rheostat is adjusted till the LED starts glowing.
- Corresponding voltage across the LED is measured using voltmeter, which is the Knee voltage.
- The experiment is repeated by changing the LED and the corresponding knee voltage is noted. The value of Planck's constant found using the formula.

CALCULATION

$$h = \frac{e\lambda V}{c} \text{ J-s}$$

i) Colour of LED –RED

Wavelength – λ – 625 nm

ii) Colour of LED –YELLOW

Wavelength – λ – 586 nm

iii) Colour of LED –GREEN

Wavelength – λ – 565 nm

iv) Colour of LED –BLUE

Wavelength – λ –460 nm

RESULT

The calculated value of Planck constant using the four different wavelength LEDs are given below,

Colour of LED	Planck's constant (h) Js
Red	
Yellow	
Green	
Blue	

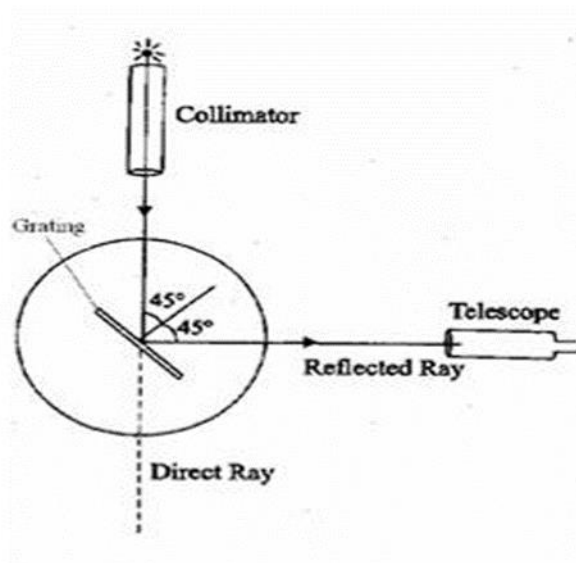


Fig. 4.1. To set for normal incidence position

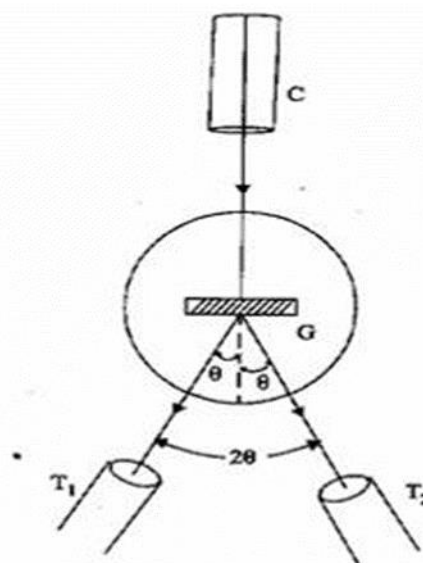


Fig. 4.2. Diffracted ray from grating

DETERMINATION OF LEAST COUNT

$$2\text{MSD} = 1^\circ$$

$$1\text{MSD} = 1/2^\circ = 0.5^\circ = 30'$$

$$\text{LC} = 1 \text{ MSD} - 1 \text{ VSD}$$

Number of divisions in Vernier scale = 30

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

$$1 \text{ VSD} = 29/30 \times \text{MSD} = 29/30' \times 30' = 29'$$

$$\text{LC} = 30' - 29'$$

$$\text{LC} = 1' \text{ (One minute)}$$

4. DETERMINATION OF WAVELENGTH OF MERCURY SPECTRUM- SPECTROMETER GRATING

AIM

To determine the wavelength of the mercury spectrum using the spectrometer grating.

APPARATUS REQUIRED

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

PRINCIPLE

A transparent grating with opaque rulings forms a parallel slit, allowing light to pass through. The angle of diffraction depends on the wavelength and the number of lines per meter on the grating.

FORMULA

The wavelength of the spectral lines of mercury spectrum

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

Symbol	Explanation	Unit
θ	Angle of diffraction	degree
N	Number of lines/ metre on the grating	lines/ metre
n	Order of spectrum	-

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

Least count = 1'

Order of the spectrum $n = 1$
 $TR = MSR + (VSC \times LC)$

$N = \dots\dots\dots$ lines/meter

Spectral lines (colours)	Readings for diffracted image												Mean angle of diffraction θ	$\lambda = \frac{\sin \theta}{n N}$
	Left Side						Right side							
	Vernier A (A ₁)			Vernier B (B ₁)			Vernier A (A ₂)			Vernier B (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.		
Violet													deg.	meter
Blue														
Green														
Yellow														
Red														

PROCEDURE

- The spectrometer is adjusted to normal incidence by mounting the grating on a grating table, aligning the slit with the vertical cross wires, and adjusting the vernier scales.
- The telescope is rotated 90° and the grating table is adjusted until the image coincides with the vertical cross wire.
- The light from the collimator incident normally on the grating, and the telescope is released. (Fig 4.1).
- The first order diffracted images are visible on either side of the central direct image (Fig 4.2), with prominent lines in violet, blue, bluish green, green, yellow, and red of the mercury spectrum are tabulated to determine the wavelength of each spectral line.

CALCULATION

Order of the spectrum

$$n = 1$$

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

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

Wavelength for violet,

$$\lambda_v = \dots\dots\dots \text{\AA}$$

Wavelength for blue

$$\lambda_B = \dots\dots\dots \text{\AA}$$

Wavelength for green

$$\lambda_G = \dots\dots\dots \text{\AA}$$

Wavelength for yellow

$$\lambda_Y = \dots\dots\dots \text{\AA}$$

Wavelength for red

$$\lambda_R = \dots\dots\dots \text{\AA}$$

RESULT

Wavelength of various spectral lines

S.No	Colour of the spectrum	wavelength $\text{\AA}$
1	Violet	
2	Blue	
3	Green	
4	Yellow	
5	Red	

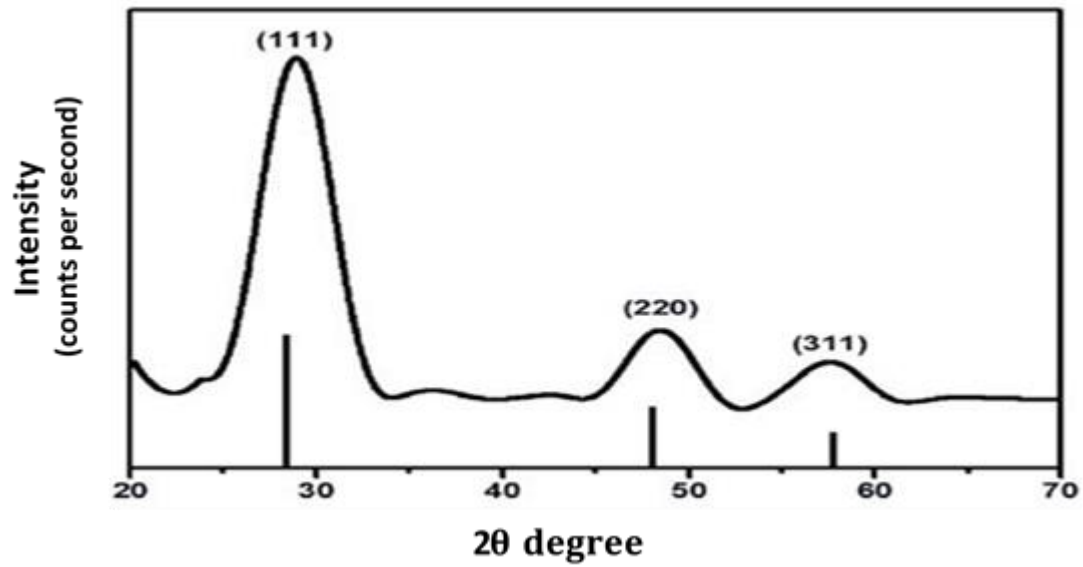


Fig 5.1 XRD pattern

h, k, l	$h^2 + k^2 + l^2$	h, k, l	$h^2 + k^2 + l^2$
100	1	300	9
110	2	310	10
111	3	311	11
200	4	322	12
210	5	320	13
211	6	321	14
220	8	400	16
221	9	410	17

Table 5.1 Value of $h^2 + k^2 + l^2$ for different planes

5. CALCULATION OF LATTICE CELL PARAMETER - X-RAY DIFFRACTION METHOD

AIM

To calculate the lattice cell parameters from the powder X-ray diffraction data.

APPARATUS REQUIRED

Powder X-ray diffraction diagram

PRINCIPLE

Crystalline substances act as X-ray diffraction gratings, producing constructive interference when Bragg's Law is satisfied, relating the wavelength of electromagnetic radiation to the diffraction angle and lattice spacing.

FORMULA

For a cubic crystal,

$$\text{The lattice constant} \quad a = \frac{\lambda}{2 \sin \theta} \sqrt{h^2 + k^2 + l^2} \quad \text{\AA}$$

$$\text{The interplanar distance} \quad d = \frac{a}{\sqrt{h^2 + k^2 + l^2}} \quad \text{\AA}$$

Symbol	Explanation	Unit
a	Lattice constant	\AA
d	Interplanar distance	\AA
λ	Wavelength of the Cu K α radiation (1.5405 \AA)	\AA
(h k l)	Miller indices	-

PROCEDURE

From the 2θ values on a powder photograph, the θ values are obtained. The $\sin^2 \theta$ values are tabulated. From that the values of $1 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{\min}}$, $2 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{\min}}$, $3 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{\min}}$ are determined and are tabulated. The values of $3 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{\min}}$ are rounded to nearest integer, this gives the value of $(h^2 + k^2 + l^2)$. From these the values of (hkl) are determined from the Table.5.1. From the (hkl) values, the lattice parameters are calculated using the relation .

To find the Value of $(h^2 + k^2 + l^2)$ for different planes

S. No	2θ deg	θ deg	$\sin \theta$	$\sin^2 \theta$	$1 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{min}}$	$2 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{min}}$	$3 \times \frac{\sin^2 \theta}{[\sin^2 \theta]_{min}}$	$h^2 + k^2 + l^2$	h k l	a Å	d Å

CALCULATION

The lattice parameter

$$a = \frac{\lambda}{2 \sin \theta} \sqrt{h^2 + k^2 + l^2} \text{ \AA}$$

The interplanar distance

$$d = \frac{a}{\sqrt{h^2 + k^2 + l^2}} \text{ \AA}$$

Result:

The lattice parameters are calculated theoretically from the powder X-ray diffraction pattern.

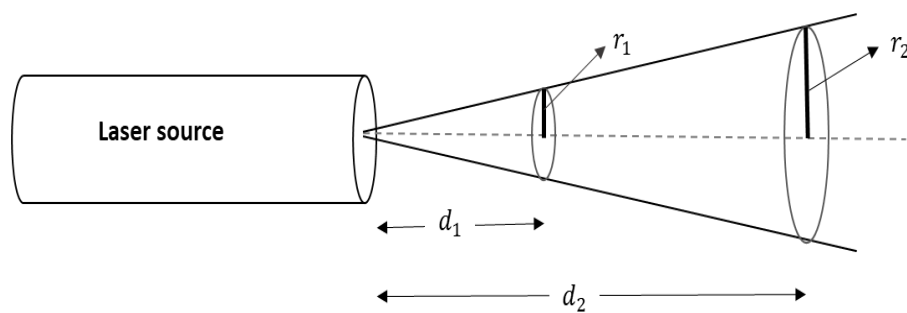


Fig.A. Angle of divergence

Determination of Angle of divergence

S.No.	r_1	r_2	d_1	d_2	$\phi = \frac{r_2 - r_1}{d_2 - d_1} \times \frac{180}{\pi}$
	m	m	m	m	degree
1.					
2.					
3.					
4.					

EXPERIMENT BEYOND SYLLABUS

A. DETERMINATION OF ANGLE OF DIVERGENCE

AIM

To determine the Angle of Divergence of the given laser light.

APPARATUS

Laser source , screen and meter scale.

FORMULA

Angle of Divergence

$$\phi = \frac{r_2 - r_1}{d_2 - d_1} \times \frac{180}{\pi} \text{ degree}$$

Symbol	Explanation	Unit
r_1	Radius of the beam spot at the distance d_1	metre
r_2	Radius of the beam spot at the distance d_2	metre

PROCEDURE

- The angle of divergence gives the angular spread of the laser beam . A diagrammatic explanation of finding the angle of divergence is shown Fig .A
-
- Here the laser source and a stand is kept at a distance say d_1 and the radius of the beam spot is measured .Now, by varying the distance to d_2 , the radius of the beam spot is again measured.
- Substituting these values in the given formula, the angle of divergence can be calculated. The experiment is repeated for various values of d_1 and d_2 and the mean angle of divergence is determined.

L

CALCULATION

Angle of Divergence

$$\phi = \frac{r_2 - r_1}{d_2 - d_1} \times \frac{180}{\pi} \text{ degrees}$$

RESULT

Angle of divergence = degree

VIVA QUESTIONS AND ANSWERS

LASER PARAMETERS

1. Define LASER

The term LASER stands for Light Amplification by Stimulated Emission of Radiation. It is a device which produces a powerful, monochromatic collimated beam of light in which the waves are coherent.

2. What is diffraction?

The bending of light around the corners or edges of the obstacles is called diffraction.

3. What is a grating?

A grating is a device consists of large number of parallel slits of same width separated by equal opaque spaces.

4. If the number of lines drawn on the grating are increased, then what happens?

If we increase the number of lines, the widths of the diffraction lines will decrease so that they will produce less overlap and make it better to distinguish the wavelengths.

5. What is meant by acceptance angle?

It is the maximum angle at or below which the light ray suffers total internal reflection

6. How does the light propagate through optical fiber?

The light propagated through optical fiber by total internal reflection.

7. How should be the value of numerical aperture for a fiber?

Numerical aperture is nothing but the light collecting ability of the fiber. So the value should be high.

RIGIDITY MODULUS- TORSIONAL PENDULUM

1. What is torsional pendulum?

A body suspended from a rigid support by means 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 possess rigidity. Hence there is no question of determining it.

4. What is the rigid body you can use for a torsional pendulum?

Sphere, cylinder or circular disc

DETERMINATION OF PLANCK'S CONSTANT USING LED**1. What is Planck's quantum theory?**

According to Planck's quantum theory, energy is not emitted or absorbed continuously, but rather in discrete packets called quanta.

2. How does LED emit the light?

When a forward voltage is applied to the LED, electrons in the n-type material and holes in the p-type material recombine at the junction, releasing energy in the form of photons.

3. What is knee voltage?

The minimum forward voltage that a PN-junction diode needs to start conducting significant current.

4. Why is knee voltage different for different colour LEDs?

The knee voltage differs between different coloured LEDs because each colour is obtained using different semiconductor materials with varying band gap energies.

5. How does Knee voltage vary with wavelength?

Knee voltage is inversely proportional to the wavelength of light emitted by a diode

SPECTROMETER GRATING**1. What is a spectrometer used for?**

A spectrometer is used to measure the angles of diffraction and wavelengths of light using optical components like prisms or diffraction gratings.

2. What is a diffraction grating?

A diffraction grating is an optical device with a large number of parallel and closely spaced slits that diffract light to produce a spectrum.

3. What is the least count of a spectrometer?

It is the smallest angle that can be measured using the spectrometer. It is usually 1' (minute) or 30" (seconds) depending on the instrument.

4. What is grating element?

It is the distance between the centers of any two successive ruled lines or transparent stripes.

5. If the number of lines drawn on a grating are increased then what happens to wavelength?

When the number of lines on a grating is increased, the wavelength of light remains unchanged. However, the diffraction angle increases for the same wavelength, improving the spectral resolution

X-RAY DIFFRACTION**1. What are lattice parameters ?**

The lattice parameters are the quantities specifying a unit cell or the unit of the periodicity of the atomic arrangement. The lattice parameters (constants) are composed of "a, b, c," lengths of the unit cell in three dimensions, and " α , β , γ ," their mutual angles.

2. What is the basic principle of XRD?

XRD techniques are based on the elastic scattering of X-rays from structures that have long range order. The X-rays get diffracted by a crystal because the wavelength of X-rays is similar to the inter-atomic spacing in the crystals.

3. What is the Bragg's law of XRD?

XRD follows Bragg's law in that the reflected X-rays from different crystal layers with long range order undergo constructive interference. This causes high-intensity peaks in the spectrum. For materials without long range order such as amorphous systems, no peaks are observed.

4. What are miller indices?

Miller indices are a notation system used in crystallography to describe the orientation of atomic planes within a crystal lattice.

DATA OF PHYSICAL CONSTANTS & STANDARD VALUES

Physical Constants	Symbol	Value in SI Unit
Velocity of light	c	$3 \times 10^8 \text{ m/s}$
Acceleration due to gravity	g	9.8 m/s^2
Planck's constant	h	$6.625 \times 10^{-34} \text{ Js}$
Charge of an electron	e	$1.69 \times 10^{-19} \text{ C}$
Avogadro number	N_A	$6.023 \times 10^{26} \text{ atoms/ k mole}$
Boltzmann constant	k	$1.38 \times 10^{-23} \text{ J/K}$
Modulus of Rigidity of Steel	η	$7.9 \times 10^{10} \text{ N/m}^2$
Wavelength of mercury vapour lamp	λ_v λ_B λ_G λ_{YI} λ_R	$4047 \text{ \AA}$ $4358 \text{ \AA}$ $5461 \text{ \AA}$ $5770 \text{ \AA}$ $6234 \text{ \AA}$