VEMU INSTITUTE OF TECHNOLOGY

P.KOTHAKOTA, CHITTOOR DIST – 517 112

DEPARTMENT OF HUMANITIES & SCIENCES

APPLIED PHYSICS

LABORATORY MANUAL FOR I Year B.Tech

(EEE, ECE, CSE, CSE (AI) & CSIT Branches)

DEPARTMENT OF HUMANITIES & SCIENCES

APPLIED PHYSICS LAB MANUAL

VEMU INSTITUTE OF TECHNOLOGY

P.KOTHAKOTA, CHITTOOR DIST – 517 112

Name	
Reg. No.	
Branch/Section	

Prepared by: **Dr. U. SASIKALA**

N. SUBRAMANYAM

Dr. P. GEETHA

Dr. A. SUDHARANI

SYLLABUS

(Common to EEE, ECE, CSE, CSE(AI) & CSIT Branches)

APPLIED PHYSICS LABORATORY: EXPERIMENTS

1. Determination of thickness of the thin wire using Wedge Method.
2. Determination of radius of curvature of a plano convex lens using Newton's rings.
3. Determination of wavelength of mercury spectrum lines using a diffraction grating in normal incidence method.
4. Determination of dispersive power of a diffraction grating.
5. Laser- Determination of wavelength using diffraction grating.
6. Determination of particle size by using laser source.
7. Determination of acceptance angle and numerical aperture of an optical fiber.
8. Determination of Dielectric constant of dielectric material using charging and discharging of capacitor.
9. Magnetic field along the axis of s circular current carrying coil - Stewart & Gee's method.
10. Determination of energy gap of a semiconductor.

Course Outcomes for Applied physics Lab (R20)

CO 1: To understand the role of Optical fiber parameters in engineering applications.
CO2: To recognize the significance of laser by studying its characteristics and its application in finding the particle size.
CO3: To illustrates the magnetic, dielectric and semiconductor materials applications.
CO4: To determine thickness of a hair/paper and wavelength of a given light source with the concept of interference
CO5: To estimate the wavelength of different colors using diffraction grating and determine resolving power of prism

CONTENTS

APPLIED PHYSICS LAB

LABORATORY INSTRUCTIONS

1. While entering the Laboratory, the students should wear shoes and lab uniform. Female Students should tie their hair back.
2. The students should bring their observation note book, practical manual, record note book and calculator and necessary stationary items for the lab classes without which the students will not be allowed for doing the practical.
3. The student should not perform unauthorized experiments.
4. All the equipments should be handled with utmost care. Any damage will be charged.
5. At the end of practical class the apparatus should be arranged neatly.
6. Each experiment after completion should be written in the observation note book and should be corrected by the lab in charge on the same day of the practical class.
7. Each experiment should be written in the record note book only after getting signature from the lab in charge in the observation note book.
8. Record note book should be submitted in the following after completion of Experiment.
9. 100% attendance should be maintained for the practical classes.

EXPT-1 **Date:**

DETERMINATION OF THICKNESS OF THE THIN WIRE USING WEDGE METHOD

Aim: To determine the thickness of given wire by Wedge method using travelling microscope.

Apparatus:

1. Travelling microscope
2. Plane glass plates
3. Reading lens
4. Sodium vapour lamp
5. Thin wire (or) hair (or) a piece of paper
6. Black paper
7. Reading lens
8. Retard stand

Formula:

Thickness of thin wire, $t = \frac{\lambda d}{2\beta}$

Where λ = wavelength of sodium light = 5893 Å

d = distance of the object from edge of the wedge

β = fringe width

Procedure:

1. A small piece of paper, wire or hair is introduced between two glass plates at one end as shown in figure.

2. This set up is carefully kept on a black paper and placed on the platform of travelling microscope. The air wedge thus formed is illuminated normally by monochromatic light (sodium vapour lamp).

3. The glass plate which is fixed at 45° is helpful in dividing the light into parts. The microscope is adjusted and focused until the parallel fringes are formed. Starting from one side coincide the cross wires tangential to the parallel fringes and note the reading for every 5 fringes (5^{th}, 10^{th}, 15^{th} etc.,) upto 25^{th} fringe.

4. Fringe width β is determined from tabular column and thickness of the wire is determined by using the formula: $t = \frac{\lambda d}{2\beta}$

Diagram:

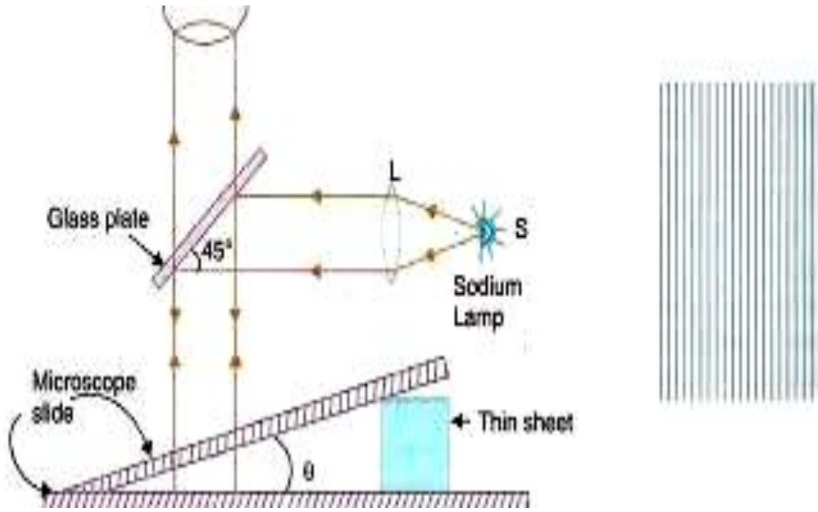


Fig: Wedge method

Least count: 0.001 cm

S.No.	Fringe no.	Microscope reading			Total (a+b) cm	Width of 5 fringes (5β) cm	Fringe width (β) cm
		MSR a (cm)	VSR n	Fraction b=n X LC (cm)			
1.	0						
2.	5						
3.	10						
4.	15						
5.	20						
6.	25						

Calculations:

Precautions:

1. The microscope should move in one direction from left to right (or) right to left, so the back lash error is avoided.

2. To achieve good accuracy in the measurement of ‘t’ should be repeated twice or thrice.

Result:

Thickness of the given foil is = -------------- cm

EXPT-2 **Date:**

NEWTON'S RINGS

Aim: To determine the radius of curvature of the given plano convex lens using Newton's rings.

Apparatus:

1. Plane glass plate,
2. Plano convex lens,
3. Black sheet,
4. Travelling microscope,
5. Retard stand,
6. Reading lens,
7. Sodium vapour lamp.

Formula:

The radius of curvature of the plano convex lens

$$\mathbf{R} = \frac{D_m^2 - D_n^2}{4\lambda(m-n)} \ \mathbf{cm}$$

Where D_m = Diameter of m^{th} dark ring – cm

D_n = Diameter of n^{th} dark ring – cm

λ = wavelength of sodium light = 5893 Å

m, n = number of choosen rings

Procedure:

1. A glass plate is kept on a black paper. The given plano convex lens is placed on the plane glass plate. Another glass plate is arranged at 45 ° to the horizontal above the plano convex lens with the help of retord stand.

2. The above unit is kept on the travelling microscope platform and under the microscope.

3. Parallel beam of monochromatic light is incident on the plane glass plate at 45° and hence a beam is incident on the plano convex lens.

4. A path of the incident light is reflected by the plano convex lens and a path of light is transmitted which is reflected from the surface of the plane glass plate. Hence, interference fringes are formed in between the glass plate and the bottom of the plano convex lens which can be observed through the microscope.

5. The microscope is moved to the one side (say left side) and the vertical cross wire is made tangential to the 18th, 15th etc., up to 3rd ring. The horizontal scale reading of the travelling microscope is noted.

6. The vertical cross wire is made tangential to the other side (say right side) of the rings 3rd, 6th etc., up to 18th ring. The horizontal scale readings are noted in the tabular form.

7. From the tabular form, the value of D_m^2, D_n^2 are calculated.

8. The radius of the curvature of the given plano convex lens is determined using the formula

$$R = \frac{D_m^2 - D_n^2}{4\lambda(m-n)} \text{ cm}$$

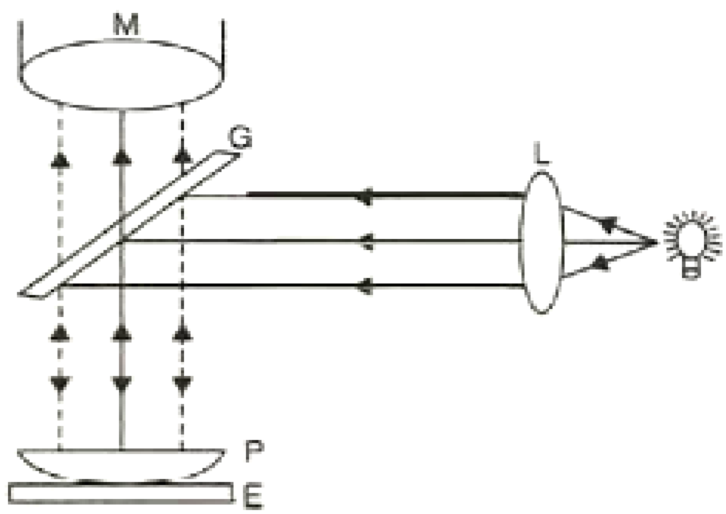


Fig. 1: Newton's ring apparatus

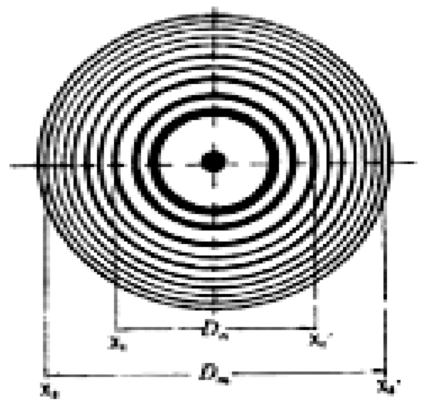
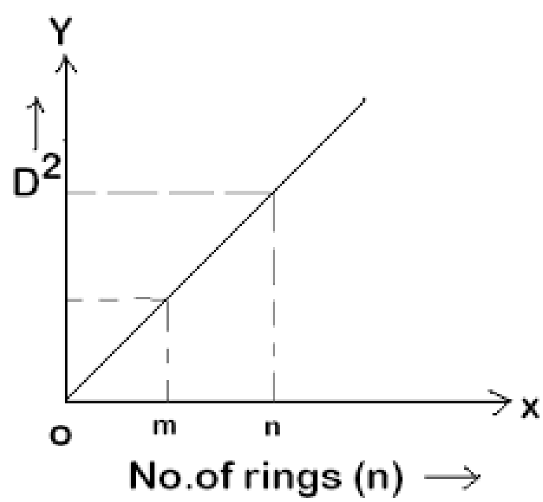


Fig. 2: Newton's Rings

Graph:

A graph is drawn by taking number of rings on x-axis and D^2 value on y-axis. The graph is a straight line passing through the origin. From the graph D_m^2, D_n^2 are calculated then 'R' can be known from the formula.



Precautions:

1. Microscope should be moved only in one direction to avoid backlash error.
2. Slow motion of tangential screw should be used while taking the readings.
3. The readings of central black spot need not be considered.

Table 1: Calculation of D^2 **Least Count : 0.001 cm**

S.No.	Ring no.	Travelling Microscope readings								Diameter of the ring D = (x-y) cm	D^2
		Left				Right					
		MSR a (cm)	VC (n)	b= n X Lc	Total x=(a+b) cm	MSR a (cm)	VC (n)	b= n X Lc	Total y=(a+b) cm		
1.	18										
2.	15										
3.	12										
4.	9										
5.	6										
6.	3										

Table 2:

S.No.	Ring No. n^{th}	D_n^2	Ring No. m^{th}	D_m^2	$D_m^2 - D_n^2$
1.	18		9		
2.	15		6		
3.	12		3		

Calculations:

Result:

The radius of curvature of the given plano convex lens is determined

From experiment, R = ----------------- cm

From graph, R = ----------------- cm

EXPT-3 **Date:**

NORMAL INCIDENCE METHOD

Aim: To determine the wavelength of mercury spectrum lines using a plane transmission grating in normal incident position.

Apparatus:

1. Spectrometer
2. Plane Transmission Grating
3. Spirit Level
4. Mercury Vapour Lamp

Formula:

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

$$N = \frac{\sin\theta_g}{\lambda_{gN}}$$

Where λ = wavelength of spectral line in Å

θ = angle of diffraction in degree

n = order of the spectrum (1)

N = number of lines per cm on the grating

λ_g = wavelength of given spectral lines

θ_g = Angle of diffraction of green colour

Procedure:

1. After the preliminary adjustments of the spectrometer are made, the slit is determinate with the mercury vapour lamp.

2. The grating is mounted on the prism table with the help of clamps.

3.The telescope is kept exactly opposite to the collimator are 0° and 180°, in this position, the vernier table is fixed with screws.

4. Now the telescope is turned to 90° then the grating is adjusted, such that the reflected image of the slit is made to coincide with the vertical cross wire of the telescope. At this position the vernier readings are 90° and 270°.

5. Then the prism table is rotated further 45° such that the plane of the grating is far to the collimator.

6. Now the grating is fixed in the normal incidence position. Then the telescope is rotated to the left side to observe the spectrum. Now the vertical cross wire is made to coincide with the red spectral line and the readings V_1 and V_2 are noted.

7. The experiment is repeated for other spectral lines (red to violet) and the readings are tabulated in tabular form.

8. Now the telescope is rotated to the right side and the experiment is repeated as above from violet to red and the readings V_1^1 and V_2^1 are noted in tabular form.

9. From the tabular form the wavelength of the spectral lines are calculated by using the formula:

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

Diagram:

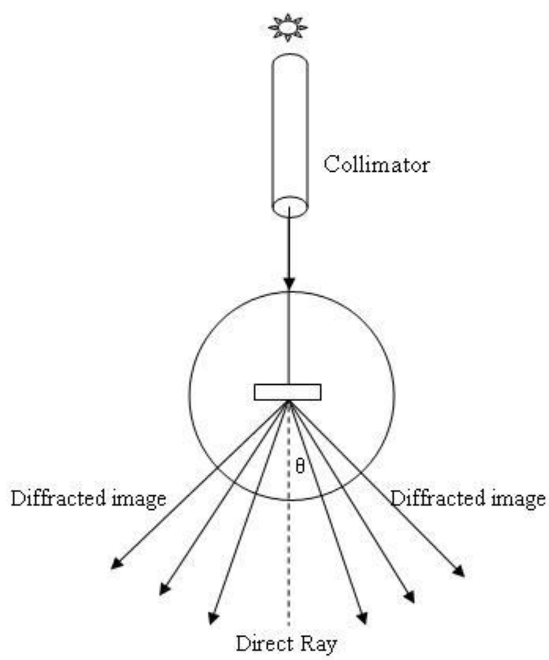


Fig. : Normal incidence method – Diffraction grating

Determination of wavelength of different spectral lines:

Least count (LC) of spectrum $= \frac{Value\ of\ MSR}{No.of\ VSR}$

$= \frac{(\frac{1}{2})^1}{30^1}$

$= 1^1$

Table

S. No	Colour	Readings on the spectrometer				Difference between vernier readings			Angle θ	$\lambda = \frac{sin\theta}{Nn}$ (Å)
		Left		Right						
		V_1	V_2	V_1^1	V_2^1	$V_1 \sim V_1^1$	$V_2 \sim V_2^1$	Mean (2θ)		
1.	Red									
2.	Yellow									
3.	Green									
4.	Blue									
5.	Violet									

Precautions:

1. The grating should be arranged in normal incidence position.

2. Micrometer screw should be used for fine adjustment of the telescope.

3. Read both the verniers to eliminate any errors due to non-coincidence of the center of the circular scale with the axis of rotation of the telescope.

Calculations:

Result:

The wavelength of the different spectral lines are determined and they are approximately equal to the standard values.

EXPT-4 **Date:**

DISPERSIVE POWER OF A PRISM

Aim: To determine the dispersive power of a given prism.

Apparatus: Spectrometer, prism, mercury vapour lamp, reading lens and spirit level.

Formula:

Refractive index of the blue colour $\mu_R = \frac{\sin(\frac{A+D_R}{2})}{\sin(\frac{A}{2})}$

Where D_R = angle of minimum deviation for red colour

Refractive index of the blue colour $\mu_R = \frac{\sin(\frac{A+D_B}{2})}{\sin(\frac{A}{2})}$

Where D_B = angle of minimum deviation for blue colour

Dispersive power of medium, $\omega = \frac{\mu_B - \mu_R}{\mu - 1}$

Where $\mu = \frac{\mu_B + \mu_R}{2}$

Procedure:

1. Rotate the prism table and telescope until light will pass symmetrically through the prism.

2. Locate the position of spectrum in field of telescope.

3. Looking at the spectrum rotate the prism table until the position of minimum deviation (D_{min}) is achieved (the position of minimum deviation is equal to the prism table is slowly moved on to one direction, for some time the spectrum moves in the same direction as prism table, but at a certain point the spectrum suddenly reverses its direction. The position where the spectrum reverses (D_{min}) its direction is called minimum deviation.

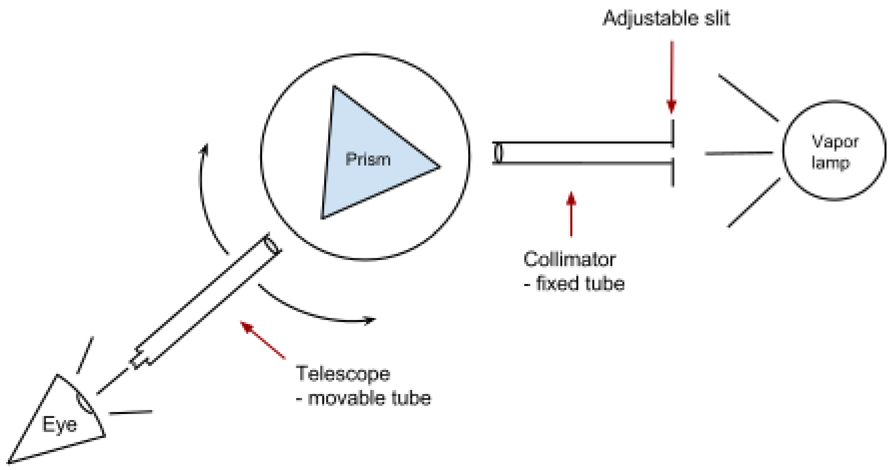


Fig. : Schematic diagram of the prism spectrometer

Observations:

1. Least count of the vernier of the spectrometer = 1 main scale division/ no. of divisions on vernier scale

2. Angle of the prism (A) = 60°

S. No.	Colour	Reading in minimum deviation position A		Direct reading B		Mean D_{min} = A-B			Value of minimum deviation
		V_I	V_{II}	V_I^1	V_{II}^1	$V_I \sim V_I^1$	$V_{II} \sim V_{II}^1$	Average	
1.	Red								D_R
2.	Blue								D_B

4. Fix the prism table in the stationary position so the spectrum will not deviate from its minimum deviation position, and use the slow motion screw fitted to the telescope to set the cross wires accurately on the centre of required colour (this reading = A)

5. Take direct reading by making telescope in line with the collimator (B).

6. The difference (A-B) will give the angle of minimum deviation.

Precautions:

1. Don't touch the polished surface of the prism with hands to avoid finger prints.

2. Use reading lens with light while taking the readings in vernier scale.

3. Slit should be as narrow as possible.

Result:

Dispersive power of the material of the prism (ω) = ---------------

EXPT-5 **Date:**

Laser - Determination of wavelength using diffraction grating

Aim: To determine the wavelength of laser light using diffraction grating.

Apparatus: Laser source, diffraction grating, clamp stand, scale.

Formula:

$$\sin\theta = \frac{d}{\sqrt{D^2+d^2}} \quad \text{and}$$

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

where θ = angle of diffraction

D = distance between grating and the screen

d = distance of diffraction spots from the central spot

n = order of the spot (1, 2, 3 -----)

N = number of lines per inch on the diffraction grating

λ = wavelength of given laser source.

Procedure:

1. Laser source is kept on the table. A grating plate is fixed vertically on a clamp stand such that the grating surface is perpendicular to the table so that the diffraction spots are seen on either side of the central spot at measurable distances.

2. The distance between the screen and the grating “D’ is measured with a scale. The distance of the diffracted spots (I order) on either side of the center spot are measured and their average value (d) is calculated.

3. The angle of diffraction ‘θ’ is calculated using the formula, $\sin\theta = \frac{d}{\sqrt{D^2+d^2}}$.

4. The wavelength of laser source (λ) is calculated by using the formula, $\lambda = \frac{\sin\theta}{Nn}$.

5. Similar calculation is made for the other orders (II and III) and the average value of λ can be calculated.

6. The experiment is repeated by changing the distance between the screen and the grating and wavelength of laser source is calculated.

Precautions:

1. Laser beam should not be seen with the nacked eye directly which may cause blindness.

2. Don’t shine the laser toward anyone.

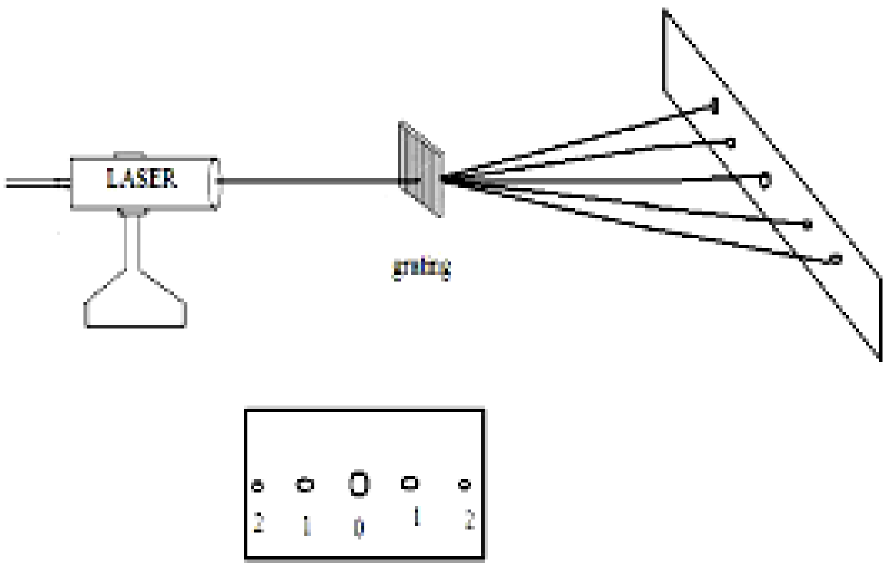


Fig.: Laser- diffraction grating

Table:

S.No.	Distance between the grating and the screen D (cm)	Order of the spot (n)	Distance from the centre spot			Sin θ = $\frac{d}{\sqrt{D^2+d^2}}$	$\lambda = \frac{\sin\theta}{Nn}$ (Å)
			Left	Right	Average (d) cm		
1.							
2.							
3.							

Calculations:

Result:

The wavelength of Laser light λ = -------------- Ǻ

EXPT-6 **Date:**

DETERMINATION OF PARTICLE SIZE BY USING LASER SOURCE

Aim: To determine the size of a particle using a laser source by forming diffraction.

Apparatus: Optical bench, laser diode, screen, particle slide, meter scale.

Formula:

Size of the particle, $a = \frac{2m\lambda D}{x}$ µm

Where m = order of the bright ring

λ = wavelength of He-Ne laser

D = distance between the particle slide and the screen (cm)

x = diameter of m^{th} bright ring (mm)

Procedure:

1. Switch on the laser source and place the particle slide in between the laser source and the screen. Allow the laser beam to fall on a particle slide.

2. The slide consists of a large number of particles. When the light from a laser source is diffracted by the particle which is present in the slide, diffraction patterns are formed on the screen.

3. Once the diffraction pattern is formed due to particle on the screen to determine its size, fix its position and note the reading on the screen. For further readings vary the distance between the slit and the screen (D).

4. By varying D, measure 'x' for bright ring of order 'm' to determine the size of particle using the formula: $a = \frac{2m\lambda D}{x}$.

5. Repeat the experiment for different orders of diffraction 'm' to determine the average size of the particle.

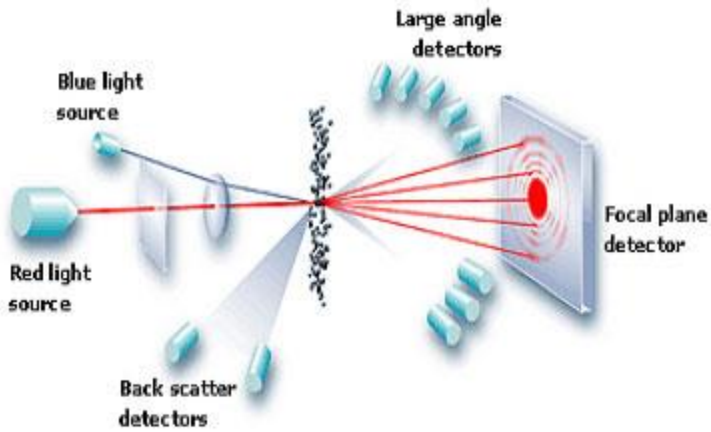


Fig. : Determination of particle size using Laser

Table:

S. No.	Distance between the particle slide and the screen (D) cm	order of the bright ring (m)	Diameter of mth dark ring (x) (mm)	Size of the particle $a = \frac{2m\lambda D}{x}$ µm
1.		1		
		2		
2.		1		
		2		
3.		1		
		2		

Precautions:

1. Laser beam should not be seen with the nacked eye directly which may cause blindness.

2. Don’t shine the laser toward anyone.

3. The laser light should be operated at a constant voltage of 220 V.

Calculations:

Result:

The size of the particle, a = ---------------- μm

EXPT-7 **Date:**

NUMERICAL APERTURE AND ACCEPTANCE ANGLE OF AN OPTICAL FIBER

Aim: To determine the acceptance angle and numerical aperture of an optical fiber.

Apparatus:

1. Fiber optical light source
2. Optical fiber cables
3. Numerical aperture
4. Optical bench

Formula:

The Numerical aperture of an optical fiber is given by,

$$NA = \sin\alpha = \frac{W}{\sqrt{4L^2+W^2}}$$

Acceptance angle, $\alpha = \sin^{-1}(NA)$

Where W = Diameter of the light falling on the screen

L = distance between the fiber end to circular image (cm)

Diagram:

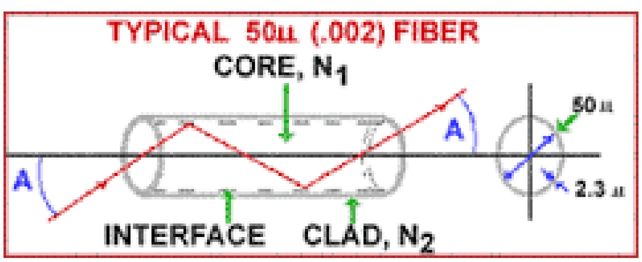


Fig.: Numerical aperture and acceptance angle of an optical fiber

Procedure:

1. One end of the optical fiber is connected to the power output of LED. And the other end of the fiber is connected to NA jig through the connector.

2. The A.C. mains is switched on. The light emitted by LED passes through the optical fiber cable to the other end. The set nob is adjusted such that, maximum intensity is observed on the screen and it should not be further disturbed.

3. A screen with concentric circles of known diameter is moved along the length of the NA jig to observe the circular spearing of light intensity on the screen.

4. The screen is adjusted such that, the first circle from the center of the screen is completely filled with the light. At this position, the distance (L) from the fiber end to the screen is noted on the NA jig.

5. The experiment is repeated for the subsequent circles by adjusting the length L along NA jig and the diameter of the rings (W) are noted in table.

6. By determining the values of 'L' and 'W', the NA and acceptance angle of the optical fiber can be calculated by using the above formulae.

Table:

S.No.	Diameter of the circular ring W (mm)	Distance from fiber end to screen L (cm)	NA = $\frac{W}{\sqrt{4L^2+W^2}}$	α = $\sin^{-1}$ (NA)
1.	5			
2.	10			
3.	15			
4.	20			
5.	25			

Calculations:

Precautions:

1. Surroundings should be perfectly dark.

2. Fiber should be coupled smoothly to the connector.

Result:

Numerical aperture of the optical fiber NA = -------

Acceptance angle of the optical fiber α = -------

EXPT-8 **Date:**

DETERMINATION OF DIELECTRIC CONSTANT USING CHARGING AND DISCHARGING OF CAPACITOR

Aim: To determine the dielectric constant of the dielectric material of the given capacitor by the method of charging and discharging.

Apparatus: Dielectric constant apparatus with variable gang capacitor and test capacitor for solid, dielectric material, connecting leads etc.

Formula: Dielectric constant of the dielectric material

$$K=\frac{C_1-C_2}{C_1-C_3}$$

Where C_1 = Capacity of standard variable capacitor at resonance (maximum deflection)

C_2 = Capacity of standard variable capacitor at resonance (maximum deflection) including test capacitor with dielectric in it

C_3 = Capacity of standard variable capacitor at resonance (maximum deflection) including test capacitor without dielectric in it

Procedure:

1. Connect the variable capacitor with the terminals marked variable capacitor on the front panel of the instrument.

2. Switch on the instrument and then set the sensitivity control knob and also rotate the standard capacitor knob for maximum deflection. At one position of standard variable capacitor the deflection should be near to 85 to 90 µA.

3. Now vary the variable capacitor to find out the resonance point (maximum deflection in the meter). Note the value of variable capacitor as C_1.

4. After getting the value of C_1, do not disturb the sensitivity knob for whole the experiment.

5. Now include the unknown test capacitor (with dielectric (all the three Bakelite sheets (7.5 mm) in it) and repeat the experiment by varying variable capacitor to again obtain resonance point (maximum deflection) in the meter. Note this value of variable capacitor as C_2.

6. Now remove the dielectric material (Bakellite sheets) from the test capacitor and repeat the experiment by varying variable capacitor to again obtain resonance point (maximum deflection) in the meter. Note this value of variable capacitor as C_3.

7. Repeat the experiment with different thickness materials.

8. Calculate the value of dielectric constant K using above formula.

Circuit Diagram:

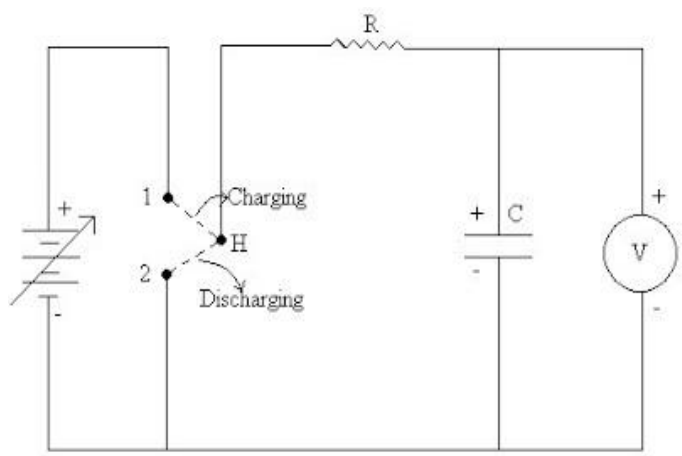


Figure 1

Table:

S. No.	Thickness of dielectric material (mm)	Value of variable capacitor at resonance when			$K=\frac{C_1-C_2}{C_1-C_3}$
		Alone C_1	With test capacitor (with dielectric in it) C_2	With test capacitor (without dielectric in it) C_3	
1.	3 mm				
2.	4.5 mm				
3.	6 mm				
4.	7.5 mm				

Calculations:

Precautions:

1. Test capacitor plates should be tight when filled with dielectric material.

2. Three sheets are provided for solid dielectric one sheet is 1.5 mm thick and other two are 3 mm each.

3. By using all the three sheets the thickness will be 7.5 mm.

Result: Dielectric constant of the dielectric material is, K = __________

EXPT-9 **Date:**

STEWART & GEE'S EXPERIMENT

Aim: To study the variation of the intensity of magnetic field along the axis of a current carrying circular coil using Stewart & Gee's type of tangent galvanometer.

Apparatus:

1. Stewart & Gee's tangent galvanometer
2. Magnetic compass
3. Ammeter
4. Commutator
5. Battery eliminator
6. Rheostat
7. Plug key
8. Connecting wires

Formula:

1. The magnetic field along the axis of a current carrying coil is given by

$$B = \frac{2\pi n i r^2}{10(d^2+r^2)^{3/2}} \text{ Gauss}$$

Where n = no. of turns of the coil = 50

i = current flowing through the coil (Amp) = 0.2 A

r = Radius of the coil (cm) = 10.1 cm

d = distance of magnetic needle from the center of the coil towards east and west

2. At the center of the magnetometer the flux density 'B' due to the current in the coil and the horizontal component of the earth's flux density B_H act at right angles to each other, so that the deflection 'θ' is given by

$$B = B_H \tan\theta$$

Where B_H = horizontal component of the earth's magnetic field = 0.38 Gauss

θ = Average angle of deflection of the magnetic needle

Circuit Diagram:

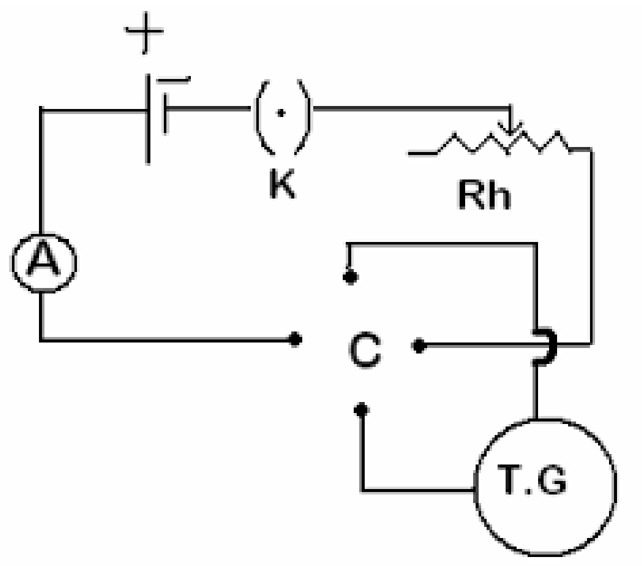
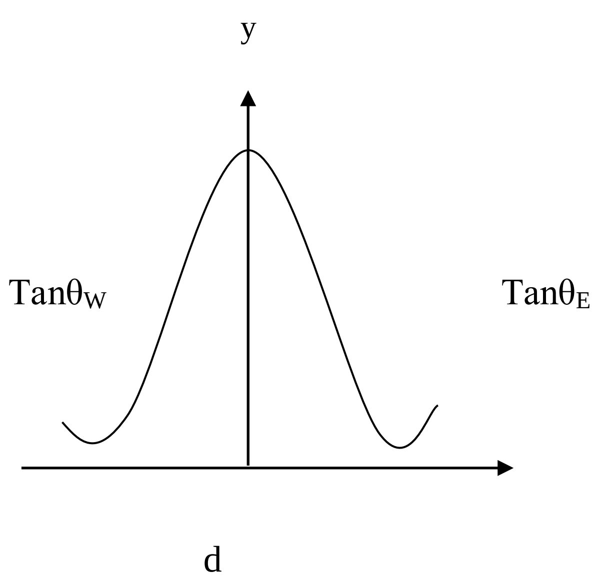


Fig.: Circuit diagram of Stewart & Gee's experiment

Graph : A graph is drawn between 'd' along x-axis and Tanθ along y-axis as shown in figure 2. It is symmetrical about the center of coil.



Procedure:

1. Orient the apparatus such that the coil is in the north-south plane as shown in the fig.

2. Adjust the leveling screws to make the base horizontal. Make sure that the compass is moving freely.

3. Connect the circuit as shown in the figure, selecting the number of turns (n) of the coil.

4. Keep the compass at the center of the coil and adjust the apparatus so that the pointers indicate 0-0 reading.

5. Close the plug keys (k) and commutator (C) (make sure that you are not shorting the power supply) and adjust the current with rheostat (Rh) so that the deflection is between 50 to 60 degrees. The current is noted by ammeter (A) and it will be kept fixed at this value for the rest of the experiment.

6. Note down the readings θ_1 and θ_2. Reverse the current by changing the commutator keys and note down θ_3 and θ_4.

7. Repeat the experiment at intervals of 2 cm along the axis towards East until the value of the field drops to 10 % of its value at the center of the coil.

8. Repeat the experiment on other sides of the coil towards West and note the deflections θ_5, θ_6, θ_7 and θ_8.

Precautions:

1. The coil and the magnetic needle are adjusted to be in magnetic meridian.

2. All the magnetic materials and current carrying conductor should be kept away from the apparatus.

3. The apparatus should be kept without any disturbance throughout the experiment.

4. Readings should be taken without parallax error.

Table:

S.No	d (cm)	Deflection in degrees								Avg. θ	Tanθ	$B=B_H$ Tanθ	$B = \frac{2\pi n i r^2}{10(d^2+r^2)^{3/2}}$
		Left arm				Right arm							
		θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8				
1.	0												
2.	2												
3.	4												
4.	6												
5.	8												
6.	10												

Calculations:

1. **For d = 0**

2. <u>For d = 2</u>

3. <u>For d = 4</u>

4. <u>For d = 6</u>

5. **For d = 8**

6. **For d = 10**

Result:

1. The magnetic fields along the axis of a current carrying coil have been computed and compared.

2. The variation of magnetic field along the axis of a current carrying coil have been studied with the help of a graph.

EXPT-10 **Date:**

DETERMINATION OF ENERGY GAP OF A SEMICONDUCTOR

Aim: To determine the energy band gap of a semiconductor.

Apparatus: p-n junction diode, thermostat, voltmeter, micro ammeter, thermometer and battery.

Formula:

Band gap energy $E_g = \frac{2.303 X 2 X k X slope}{1.6 X 10^{-19}}$ **eV**

Where k= Boltzmann constant

The graph between log I_0 vs $\frac{1}{T}$ gives the slope.

I_0 = Saturations current (mA)

T = Temperature (K^{-1})

Diagram:

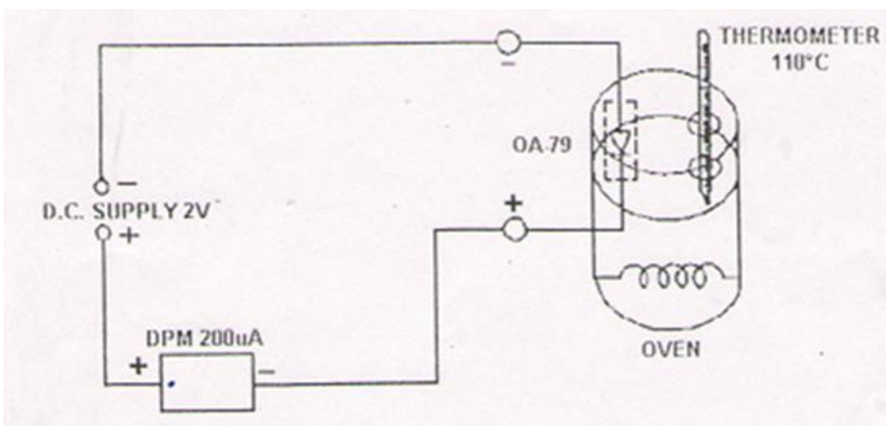


Figure: Energy gap of semi conductor

Procedure:

The circuit diagram of the experimental setup for the measurement of energy gap in shown in figure.

1. The point contact diode connected in a reverse bias as shown in the diagram.

2. It is placed in an oil bath and heated uniformly.

3. Saturation current is noted for various temperatures.

4. The bias voltage is maintained at constant value.

5. The readings in the micro ammeter is noted a function of temperature in steps of 5^0C.

6. A graph is drawn between with log (1/T)in Kelvin on X-axis and log I_0 is on Y-axis.

7. The slope of the graph is calculated and submitted in the formula.

Precautions:

1. The current flow should not be too high, if the current is high then the internal heating of the device will occur. This will cause actual temperature of the junction to be higher than the measured value. This will produce non-linearity in the curve.

2. There may be contact potentials, thermo emfs and meter dc offsets which must be added and subtracts from the readings.

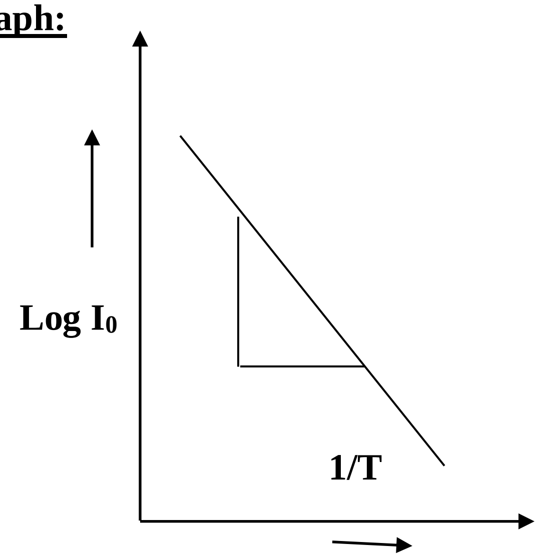
3. Poor contact results in huge variations in the results and must be carefully soldered.

4. It is better to repeat a few measurements at end of each run to check the source of error.

Table:

S.NO.	Temperature (t) ºC	Temperature T (K)	Saturation Current (I_0)	$\frac{1}{T}$ (K^{-1})	Log I_0

Model graph:



Calculations:

Result: The energy gap of the material = ------------- eV.