



MUFFAKHAM JAH

COLLEGE OF ENGINEERING & TECHNOLOGY

Autonomous & Accredited by NAAC with A+ and NBA
Affiliated to Osmania University & Approved by AICTE

ENGINEERING PHYSICS

LAB MANUAL

B.E. FIRST YEAR – SEMESTER II

NAME : _____

ROLL NUMBER : _____

BRANCH : _____

SECTION : _____ FACULTY NAME : _____

II

LIST OF STAFF MEMBERS

Physics Department

Teaching Staff

- | | |
|-----------------------------|----------------|
| 1. Dr. Shaik Kareem Ahmmad | Professor |
| 2. Mr. Syed Ilyas Mohiuddin | Asst.Professor |
| 3. Dr. Md. Raheem Ahmed | Asst.Professor |
| 4. Dr. Nazima Siddiqui | Asst.Professor |
| 5. Ms. Samera Saniya | Asst.Professor |

Non-Teaching Staff

- | | |
|-------------------------|----------------|
| 1. Mr. Atique-ur-Rehman | Lab Supervisor |
| 2. Mr. Shaik Shakeel | Lab Supervisor |

List of Experiments

Cycle-I

1. B-H Curve
2. Thermistor
3. Planck's Constant

Cycle-II

4. Solar Cell
5. P-N Junction Diode
6. Energy Band Gap
7. Hall Effect

Cycle-III

8. Laser
9. Fiber Optics
10. Newton's Rings

1. B-H CURVE

AIM: To trace the hysteresis loop of a ferromagnetic specimen using cathode ray oscilloscope (CRO) and to evaluate the energy loss (E_L)

APPARATUS: Transformer as ferromagnetic material, Cathode Ray Oscilloscope (CRO), B-H Curve kit , Trace paper, Resistors Capacitor and connecting wire.

PRINCIPLE: Magnetic Hysteresis in which B lags behind in a ferromagnetic materials.

FORMULA:

$$E_L = \frac{N_1}{N_2} \times \frac{R_2}{R_1} \times \frac{C}{AL} \times S_V \times S_H \times \text{Area of the loop in m}^2$$

Where

Length of the specimen $L = 0.28\text{m}$

Area of cross-section $A = 2 \times 1.4 \times 10^{-4} \text{sq.m}$

No. of turns in the primary $N_1 = 200$

No. of turns in the secondary $N_2 = 400$

Capacitance $C = 5.5 \times 10^{-6} \text{ F}$

Resistance $R_1 =$ given resistance of $(5 \Omega), (22 \Omega), (47\Omega)$.

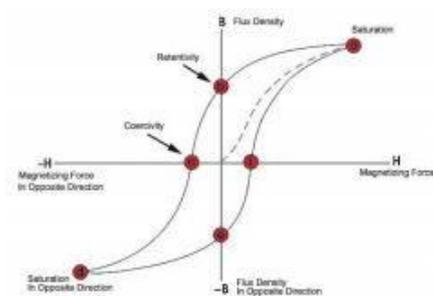
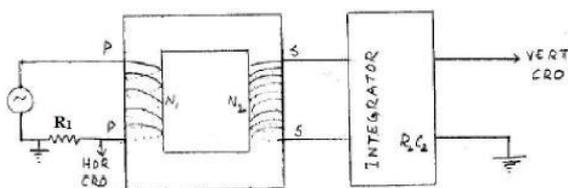
Resistance $R_2 = 2.2 \times 10^3 \Omega$

S_H is Horizontal sensitivity in volt/m

S_V is Vertical sensitivity in volt/m

UNITS: Joules/m³/cycle

DIAGRAM:



PROCEDURE:

Connect R_1 in series to the primary coil of the transformer. Connect the horizontal input of cathode ray oscilloscope (CRO) across R_1 using coaxial cable, and connect the vertical input of CRO across C_2 in the secondary of the transformer using coaxial cable. Now adjust the vertical and horizontal channels volt/div knob for producing a loop with maximum area on the CRO screen. Now trace the loop on translucent graph paper for different values of R_1 . Note the values of horizontal and vertical sensitivity using the volt/div. knob for different loops. Multiply the values of horizontal and vertical sensitivity each by 100 to convert it to volts/meter.

OBSERVATION TABLE:

Resistance R_1 (Ω)	Horizontal Sensitivity S_H (V/m)	Vertical Sensitivity S_V (V/m)	Area of the loop (m^2)	Energy loss (joule/ m^3 /cycle) using formula
5				
22				
47				

RESULT: The energy loss per unit volume per cycle is. Joule/ m^3 /cycle

Teacher's Signature

SAMPLE VIVA QUESTION

1. What is B-H curve?
2. What is hysteresis? Why hysteresis occur?
3. What is retentivity and coercivity?
4. Which ferromagnetic material used in B-H curve experiment?
5. Why AC supply is used.
6. What is hysteresis loss?
7. Give difference between soft and hard magnetic materials
8. What is magnetic domain
9. What is eddy current, where you observe in B-H curve.

2. TEMPERATURE CHARACTERISTICS OF A THERMISTOR

Aim. To study the characteristics of Thermistor and to evaluate the constants.

APPARATUS: Thermistor (NTC), Wheatstone bridge, Copper bowl containing oil, an electric oven, Thermometer, DC regulator power supply, Galvanometer, connecting wires.

PRINCIPLE: The resistance of a semiconductor changes exponentially with temperature due to increase in charge carrier.

THEORY:

A thermistor is a device sensitive to temperature variation. It consists of a mixture of oxides of cobalt, manganese; nickel with finely divided copper, The mixture is embedded in a ceramic base. It is provided with two platinum leads. Thermistors are available in many shapes such as discs, beads and rods etc. The fundamental property of a thermistor is its temperature dependence of resistance. The resistance of a thermistor has a non-linear variation with temperature. With the increase in temperature the resistance of a thermistor decreases exponentially as given by the relation $R = Ae^{\frac{B}{T}}$ (1)

Where A and B are constants and T the absolute temperature. The present experiment is to determine 'R' as a function of 'T' and to evaluate the constants A and B.

FORMULA:

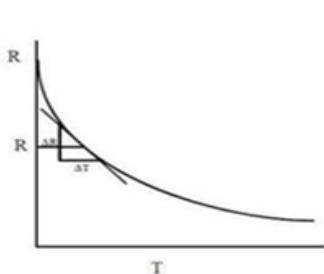
Temperature coefficient of thermistor $\alpha = \frac{1}{R} \left(\frac{\Delta R}{\Delta T} \right) / (\text{unit} - K^{-1})$

Thermistor constants A (ohms) and B (K)

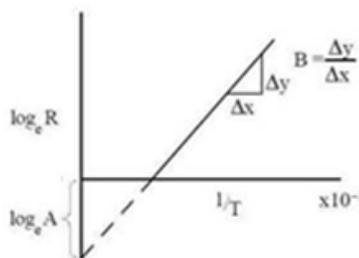
$A = e^{-x}$ Where x is the value of negative Y intercept and $B = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$

(B is the slope of line drawn between $\frac{1}{T}$ verses $\log_e R$)

MODEL GRAPH:

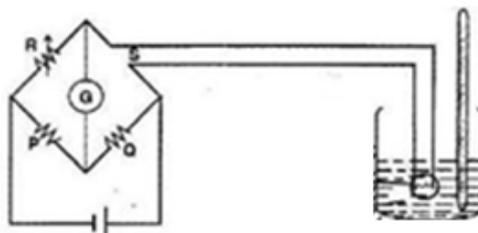


Graph(i)



Graph(ii)

EXPERIMENTAL ARRANGEMENT:



PROCEDURE:

A Wheatstone bridge is set up as shown in the figure. The thermistor is connected in the fourth arm of the bridge, while P, Q, and R are from the other three arms. P and Q represent the ratio of arms. Both of them have equal resistance. The resistance 'R' is a variable resistance. The thermistor is placed in a oil bath. The temperature is noted. The variable resistance 'R' is adjusted such that the galvanometer shows no deflection. The resistance of 'R' is equal to the resistance of the thermistor. The resistance of the thermistor is measured at different temperatures at regular intervals. The resistance and corresponding temperatures are noted. Plot a graph between resistance and absolute temperature. To evaluate the resistance's temperature coefficient, a tangent is drawn to the curve at a suitable value of R.

OBSERVATION TABLE:

S.No.	Temperature of thermistor		$\frac{1}{T}$ (K ⁻¹)	Resistance of the thermistor R	Log _e R
	t ⁰ (C)	T(K)			

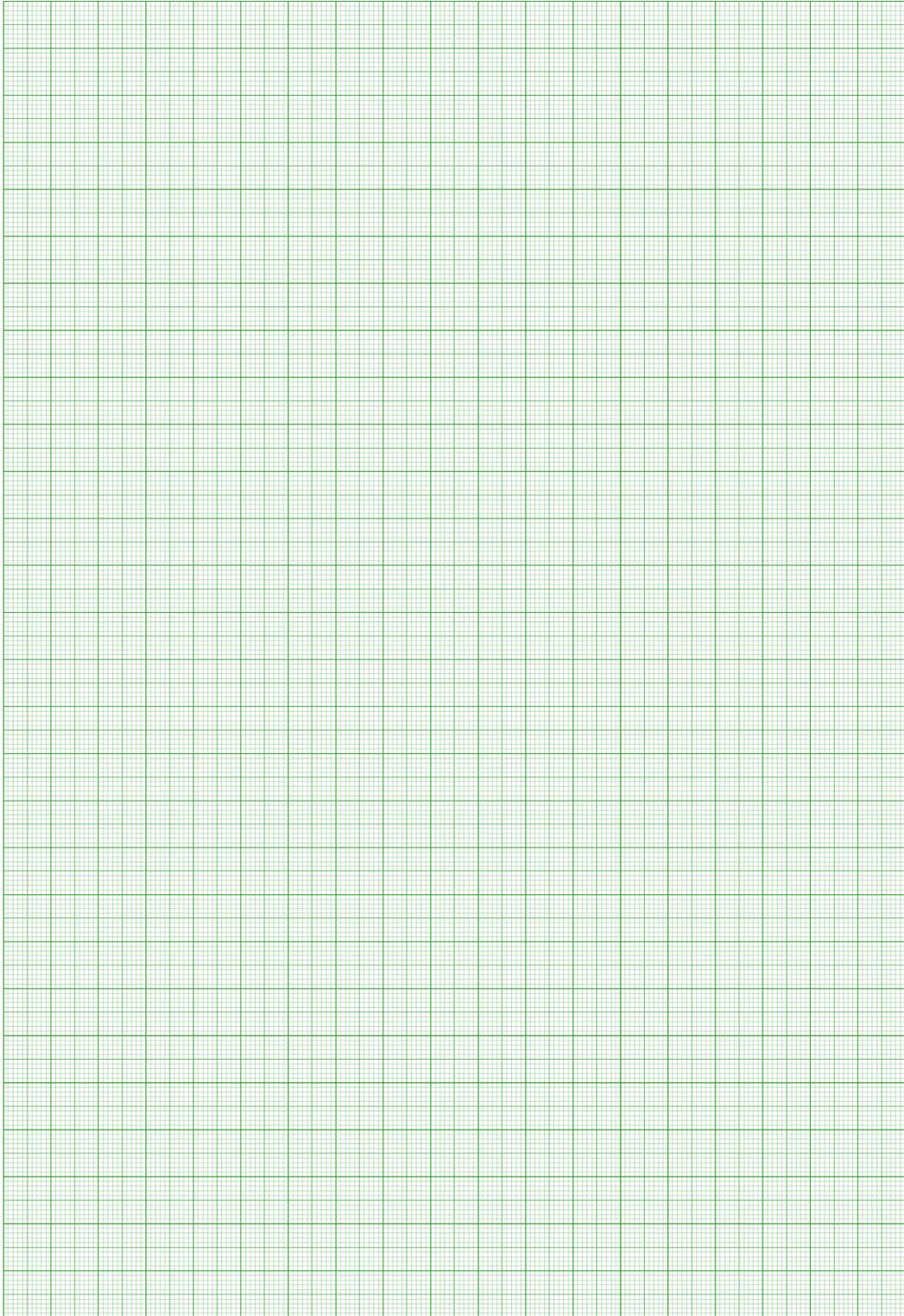
RESULTS:

1. Temperature coefficient of resistance.....K⁻¹
2. The Value of constant A =Ω
3. The value of constant B =K

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What is thermistor?
2. What is the application of thermistor?
3. How thermistor is fabricated?
4. Why the resistance of thermistor decreases with increase in temperature?
5. What is the principle of Wheastone bridge.
6. What is temperature coefficient of resistance? What are its units?
7. Types of thermistors?
8. What is the use of Constant A & B?
9. What is the use of α ?
10. Why do we use oil and not water in a thermistor experiment?



Calculations

4. PLANCK'S CONSTANT

AIM: To determine the value of Planck's Constant (h) using photocell by studying the photo electric effect and measuring the stopping potential for different frequencies of light.

APPARATUS: Photo cell, Microammeter, Voltmeter, optical filters (red, yellow, green, blue, violet), source of light, connecting wires, DC power supply.

PRINCIPLE: The principle is based on quantum relation $E = h\nu$ supplied equals the photon energy.

DEFINITION: Planck's constant is the fundamental physical constant that relate the energy of photon (E) to the frequency (ν) of its electromagnetic wave. it is denoted by h .

NOTE: It tells us that the energy in the microscopic world is quantize meaning it exist in small packed called quanta

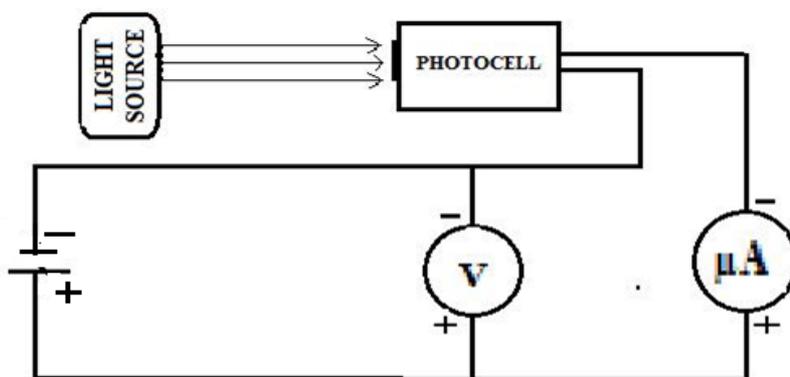
FORMULA:

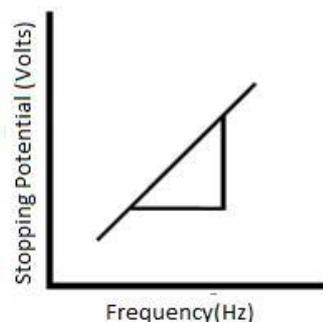
Planck's constant (h) = slope x charge of electron (J.sec)

Where charge of electron $e = 1.6 \times 10^{-19}$ coulombs

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{Stopping Potential}}{\text{Frequency}}$$

CIRCUIT DIAGRAM:



MODEL GRAPH:**PROCEDURE:**

- Make the connections.
- Light source is arranged and the light is allowed to fall on the tube which is enclosed in a box.
- The distance between photo cell and light source is adjusted such that there is sufficient flow of current (Wait for 2 to 3 minutes before taking any reading)
- Now a suitable filter of known wave length is placed in path of the light (in the slit provided). (Take red filter in the last).
- A reading is observed in the Micro-Ammeter.
- A small Negative Potential is applied and is gradually increased in step and each time reading in voltmeter and micro-ammeter is noted till the micro-ammeter reading comes to zero. This is stopping Potential V_s corresponding to filter with wave length.
- The experiment is repeated with other filters of known wavelength and corresponding stopping potentials are noted.
- A graph is plotted by taking negative anode stopping potential on Y-axis verses corresponding frequency of radiation of that particular filter on X-axis.

OBSERVATION TABLE:

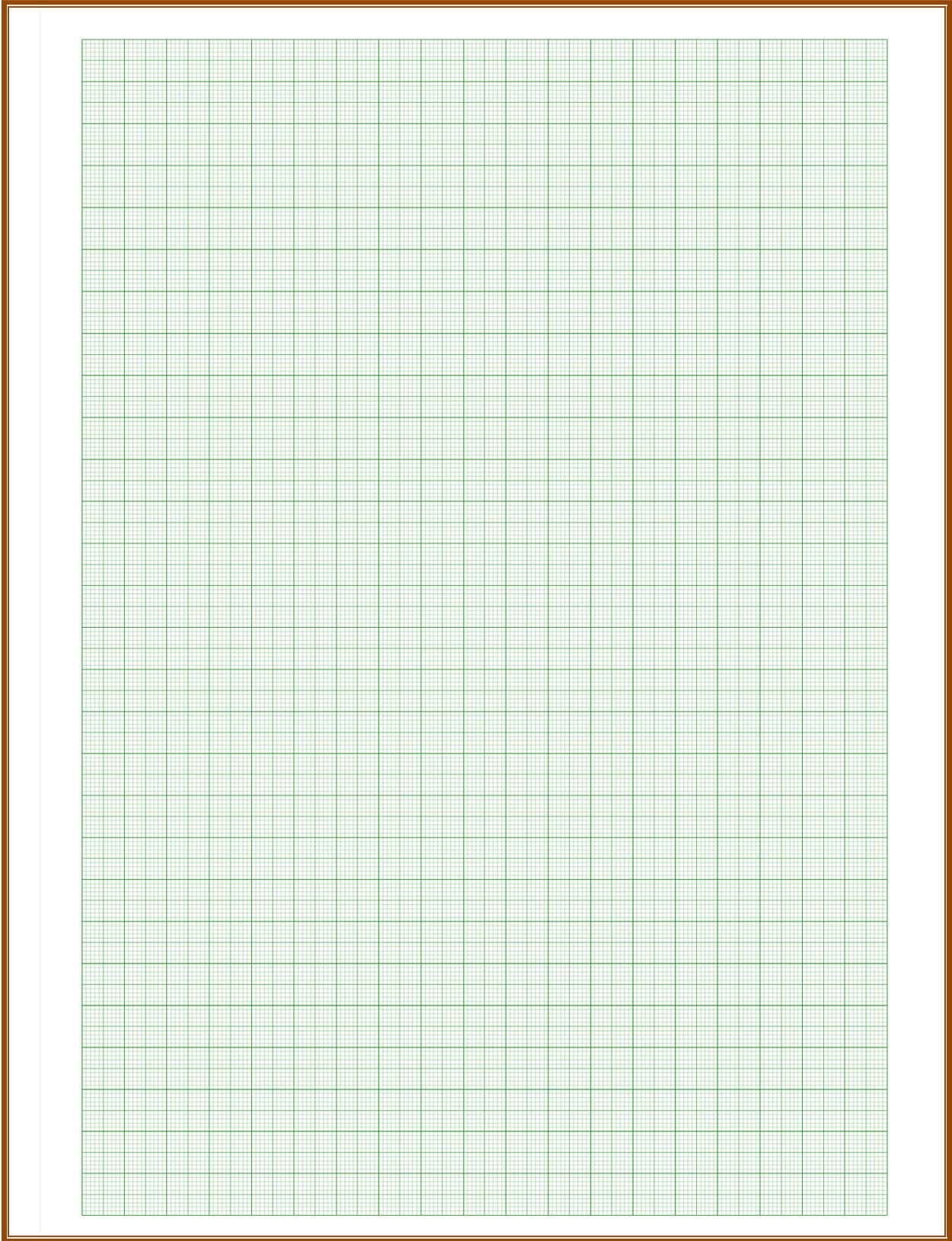
Colour of the filter	Frequency (Hz)	Stopping potential (Volts)
Red	4.687×10^{14}	
Orange	5.26×10^{14}	
Green	6.02×10^{14}	
Violet	7.407×10^{14}	

RESULT: The value of Planck's constant is J.sec

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What is Planck's constant (h) and what is its value?
2. State Planck's quantum theory.
3. Write the Einstein photoelectric equation.
4. What is the photoelectric effect?
5. What do you mean by threshold frequency?
6. Define work function of a metal.
7. What is stopping potential in the photoelectric experiment?
8. Why does increasing intensity of light not change the stopping potential?
9. How can Planck's constant be determined experimentally using the photoelectric effect?
10. What is the unit and dimension of Planck's constant?



Calculations

5. SOLAR CELL

AIM: To study (V-I) voltage current characteristics of the given solar cell and determine its Fill Factor(FF) and Series Resistance(R_S).

APPARATUS: Solar cell, Spot light Source, Voltmeter, Milliammeter, Variable resistor and connecting wires.

PRINCIPLE: Photovoltaic effect : This is the process by which semiconductor material converts light energy directly into electrical energy .

FORMULA:

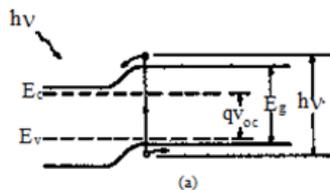
$$\text{FILL FACTOR} = \frac{I_m V_m}{I_{sc} V_{oc}} = \frac{\text{Maximum Area Rectangle}}{\text{Area of curve}}$$

Where

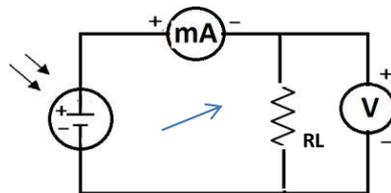
I_m is maximum current
 V_m is maximum voltage
 I_{sc} is short circuit current
 V_{oc} is open circuit voltage

$$\text{Series Resistance } R_S = \frac{1}{2} \times \left[\frac{\Delta V_1}{\Delta I_1} + \frac{\Delta V_2}{\Delta I_2} \right] \Omega$$

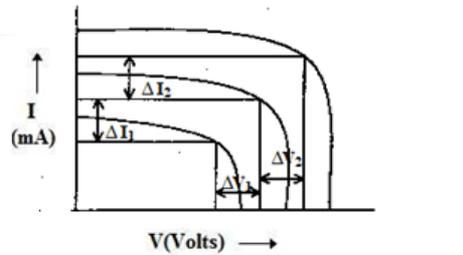
Energy band diagram of solar cell:



Circuit diagram:



Model graph:



PROCEDURE:

Connect the anode of the solar cell to the positive terminal of the ammeter and connect the negative terminal of the ammeter to one end of the load resistor, and the other end of the load resistor to the cathode of the solar cell. Then, connect the positive terminal of the voltmeter to the negative terminal of the ammeter, and the negative terminal of the voltmeter to the cathode of the solar cell.

Place the light source near the solar cell. Disconnect the load (R_L) from the solar cell and note the open circuit voltage (V_{oc}) from the voltmeter, then short-circuit the load by shorting the two terminals of the load and note the short-circuit current (I_{sc}). Now vary the load resistance and note down the readings of the voltmeter and ammeter. Repeat this process for another two sets of readings with different intensities of light by adjusting the distance of the bulb from the solar cell.

Observation Table:

$V_{oc} =$			$I_{sc} =$			$V_{oc} =$			$I_{sc} =$		
S. No.	Voltage (V)	Current (mA)	S. No.	Voltage (V)	Current (mA)	S. No.	Voltage (V)	Current (mA)	S. No.	Voltage (V)	Current (mA)

RESULT:

- Fill Factor (FF) =
- Series Resistance (R_s) = Ω

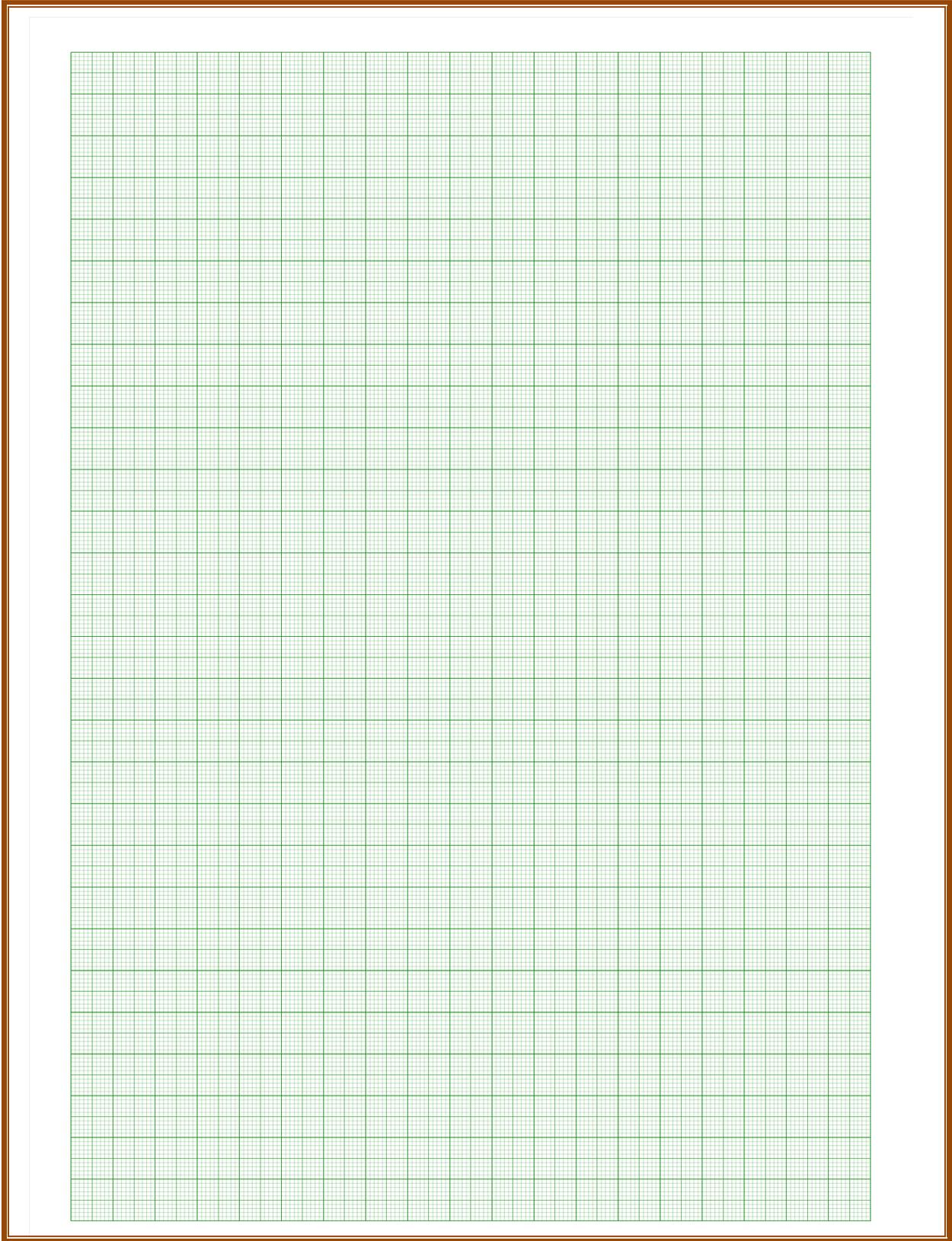
Teacher's Signature

PRECAUTIONS:

1. See that the light from the source falls normally on the solar cell.
2. Make sure that connections are made properly and ensure good contact.

SAMPLE VIVA QUESTIONS:

1. What is meant by solar cell?
2. What is the difference between Light Emitting Diode P-N junction and solar cell P-N junction?
3. What do you mean by V_{oc} and I_{sc} and explain them.
4. How does the power output of the solar cell depend on the wavelength of light falling on it?
5. On which parameter of the semiconductor, the solar efficiency mainly depends?
6. To improve the efficiency of the solar cell what are the necessary steps one has to take?
7. Explain the forward and reverse bias characteristics of the P-N junction?
8. What is the difference between photo conducting diode and photovoltaic diode?
9. How to select the semiconducting material for solar cell?
10. What is photocell?



Calculations

6. P-N DIODE CHARACTERISTICS

AIM : To study the current voltage characteristics of P-N junction diode and Zener diode to evaluate the resistance.

APPARATUS : p-n diode, voltmeter (0-1.5V), milliammeter (0-25 mA), connecting wires and potentiometer.

FORMULA

$$\text{Forward Resistanc } R_f = \frac{\Delta V_f}{\Delta I_f} = \frac{V_2 - V_1}{I_2 - I_1}$$

Where

ΔV_f change in forward voltage

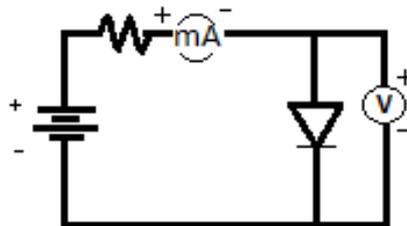
ΔI_f change in forward current

UNITS: Ohms (Ω)

PROCEDURE:

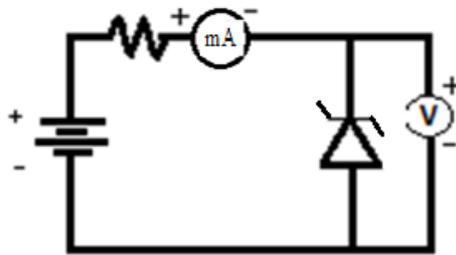
FORWARD BIASING:

Connect the positive terminal of the variable DC power supply to one end of the resistor, and the other end of the resistor is connected to the positive terminal of the milli-ammeter, and the negative terminal of the milli-ammeter is connected to the anode of the p-n junction diode. The power supply's negative terminal is directly connected to the cathode. Now connect the voltmeter across the diode such that the positive terminal is connected to the anode and the negative terminal is connected to the cathode. Now start the experiment by varying the power supply, note the voltage drop across the diode and the current passing through it. After taking the readings, plot the I-V characteristics to determine the forward resistance by drawing a tangent to the curve.

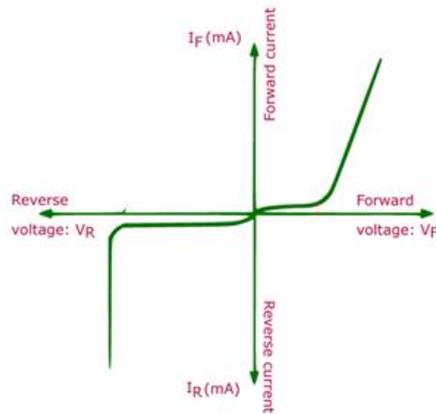


REVERSE BIASING:

Connect the positive terminal of the variable DC power supply to one end of the resistor, and the other end of the resistor is connected to the positive terminal of the milliammeter. The negative terminal of the milliammeter is connected to the cathode of the Zener diode. The negative terminal of the power supply is directly connected to the anode of the diode. Now connect the voltmeter across the diode such that the positive terminal is connected to the cathode and the negative terminal is connected to the anode. Start the experiment by varying the power supply, note the voltage drop across the diode and the current passing through it. After taking the readings, plot the I–V characteristics to determine the reverse saturation current.



MODEL GRAPH



OBSERVATION TABLE:

Forward Bias (P-N Junction Diode)	
Voltage (Volts)	Current (mA)

Reverse Bias (Zener Diode)	
Voltage (Volts)	Current (mA)

Results:

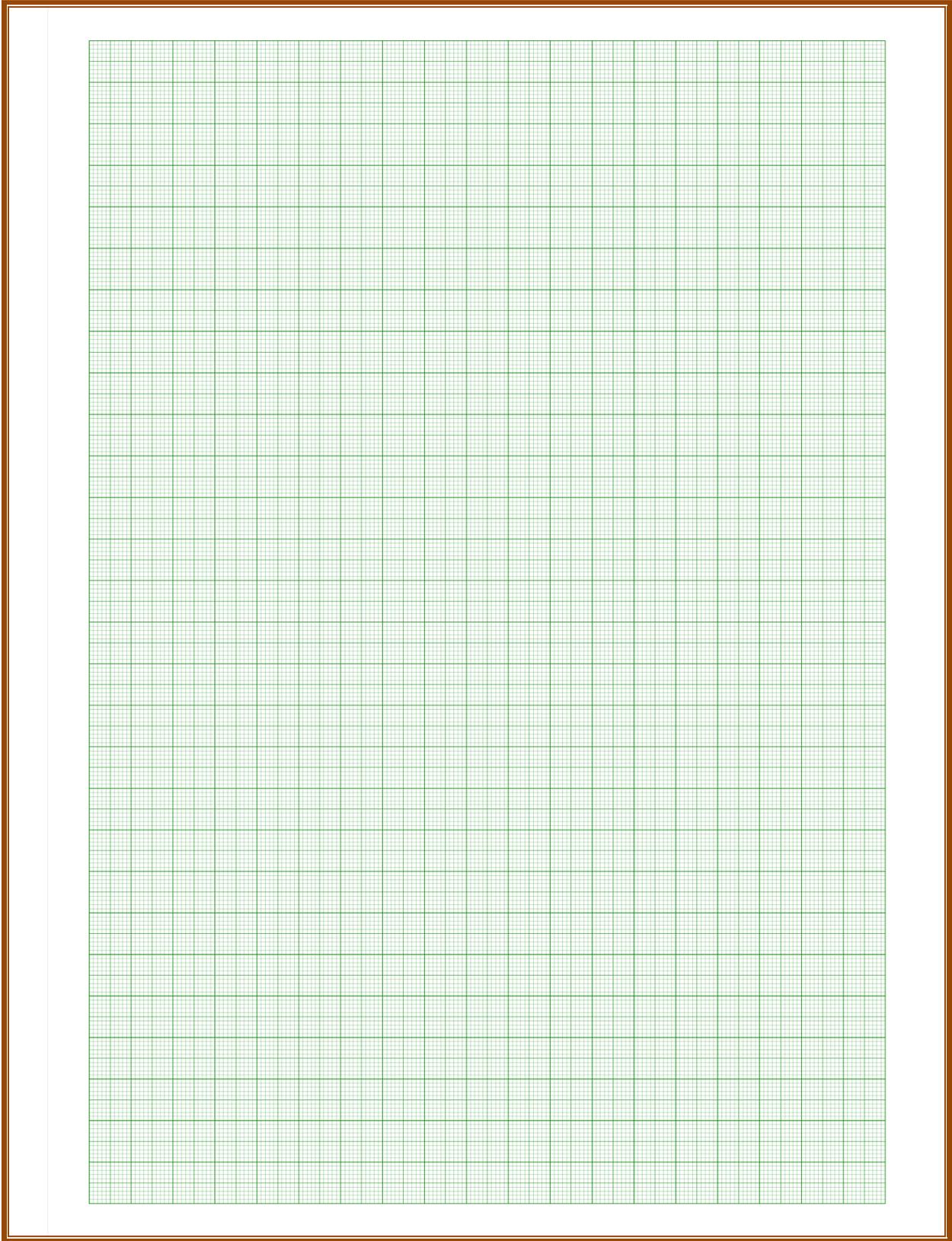
Forward resistance = Ω

Cut-in Voltage =V

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What is p-n junction?
2. What is depletion layer?
3. What is potential barrier?
4. What is forward biasing.
5. What is reverse biasing?
6. What is cut in voltage?
7. What is breakdown voltage?
8. What are majority charge carriers?
9. What are minority charge carriers?
10. Why the diode has low resistance in forward biasing
11. Why the diode has high resistance in reverse biasing.



Calculations

7. ENERGY BAND GAP OF SEMICONDUCTOR

AIM: To find the energy band gap semiconductor using a diode in reverse bias.

APPARATUS: P-N diode, Variable DC power supply, voltmeter, micro ammeter, thermometer and heating arrangement for the diode.

FORMULA: Energy band gap of semiconductor (E_g) = slope $\times 2 \times 1.38 \times 10^{-23}$ Joule

OR

$$(E_g) = \text{slope} \times 1.725 \times 10^{-4} \text{ eV}$$

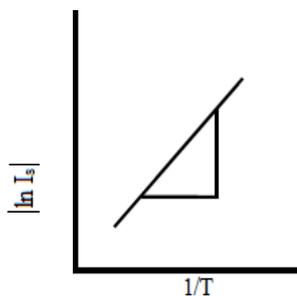
$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\ln I_s}{\frac{1}{T}}$$

Where

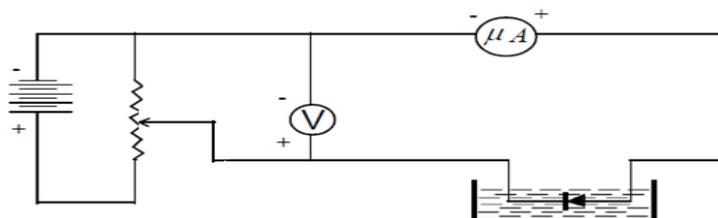
I_s is reverse saturation current

T is absolute temperature

MODEL GRAPH:



CIRCUIT DIAGRAM:



PROCEDURE:

The diode is placed in an oil bath. Now the diode is reverse biased by applying some potential difference. Note the current reading at room temperature before switching on the heater. Now switch on the heater and keep heating until the desired temperature is reached. Switch off the heater and note the current reading while the temperature of the diode decreases. Now plot the graph between the logarithm of I_s and $1/T$ a straight line is obtained in the graph. Now calculate the slope and substitute it into the formula to calculate the energy band gap in electron volts.

OBSERVATION TABLE:

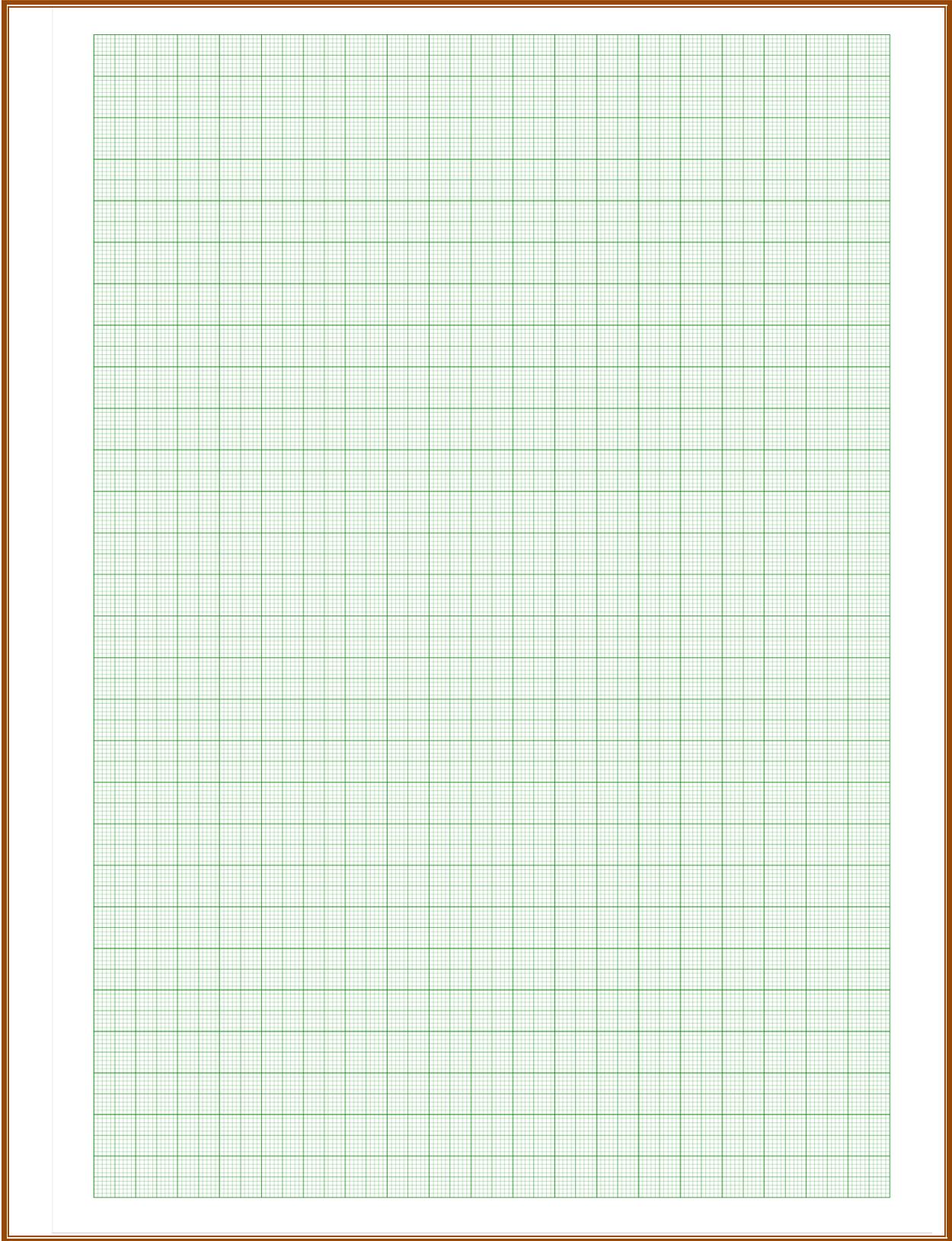
Temperature		$\frac{1}{T} (K^{-1})$	Reverse bias current $I_s (\mu A)$	$\ln I_s$
$t^\theta (C)$	T(K)			
80				
75				
70				
65				
60				
55				
50				
45				
40				

RESULT: The energy band gap of a given semiconductor is.....eV.

Teacher's Signature

SAMPLE VIVA QUESTIONS :

1. What is a semiconductor?
2. Define energy band gap
3. What is the difference between a conductor, semiconductor and insulator in terms of band gap?
4. What is the typical value of band gap for a semiconductor?
5. Give two examples of semiconductor materials and their band gap values.
6. What is the difference between valence band and conduction band?
7. Why does a semiconductor not conduct electricity as absolute zero temperature?
8. How does temperature affect the band gap of a semiconductor?
9. What is the difference between intrinsic and extrinsic semiconductor?
10. Why diode kept in reverse bias only.



Calculations

8. HALL EFFECT EXPERIMENT

Aim: To find the Hall Coefficient, Carrier concentration and Mobility of charge carrier of a given semiconducting material.

Apparatus: Semiconducting sample (Specimen), Hall Effect Setup, Hall Probe, Electromagnet, Constant current power supply and Digital Gauss meter.

Formula:

$$(i) \quad R_H = \frac{V_H \times t}{I \times B} \quad \text{Units: m}^3/\text{Coulomb}$$

Where

R_H = Hall Coefficient V_H = Hall

Voltage

I = Current through Specimen B = Applied

Magnetic field

$$(ii) \quad n = \frac{1}{R_H \times e} \quad \text{Units: m}^{-3}$$

Where

n = Carrier Concentration

e = electric charge (1.6021×10^{-19} coulomb)

R_H = Hall Coefficient

$$(iii) \quad \mu = \sigma \times R_H \quad \text{Units: m}^2 \cdot \text{V}^{-1} \cdot \text{Sec}^{-1}$$

Where

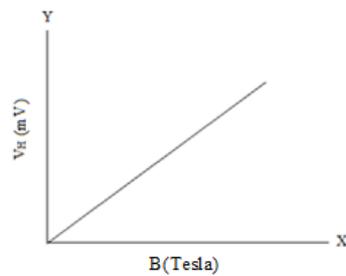
μ = Mobility of Charge Carrier

σ = Conductivity

R_H = Hall Coefficient

Note: ($\sigma = 10$ S/m for Ge Crystal)

Graph:



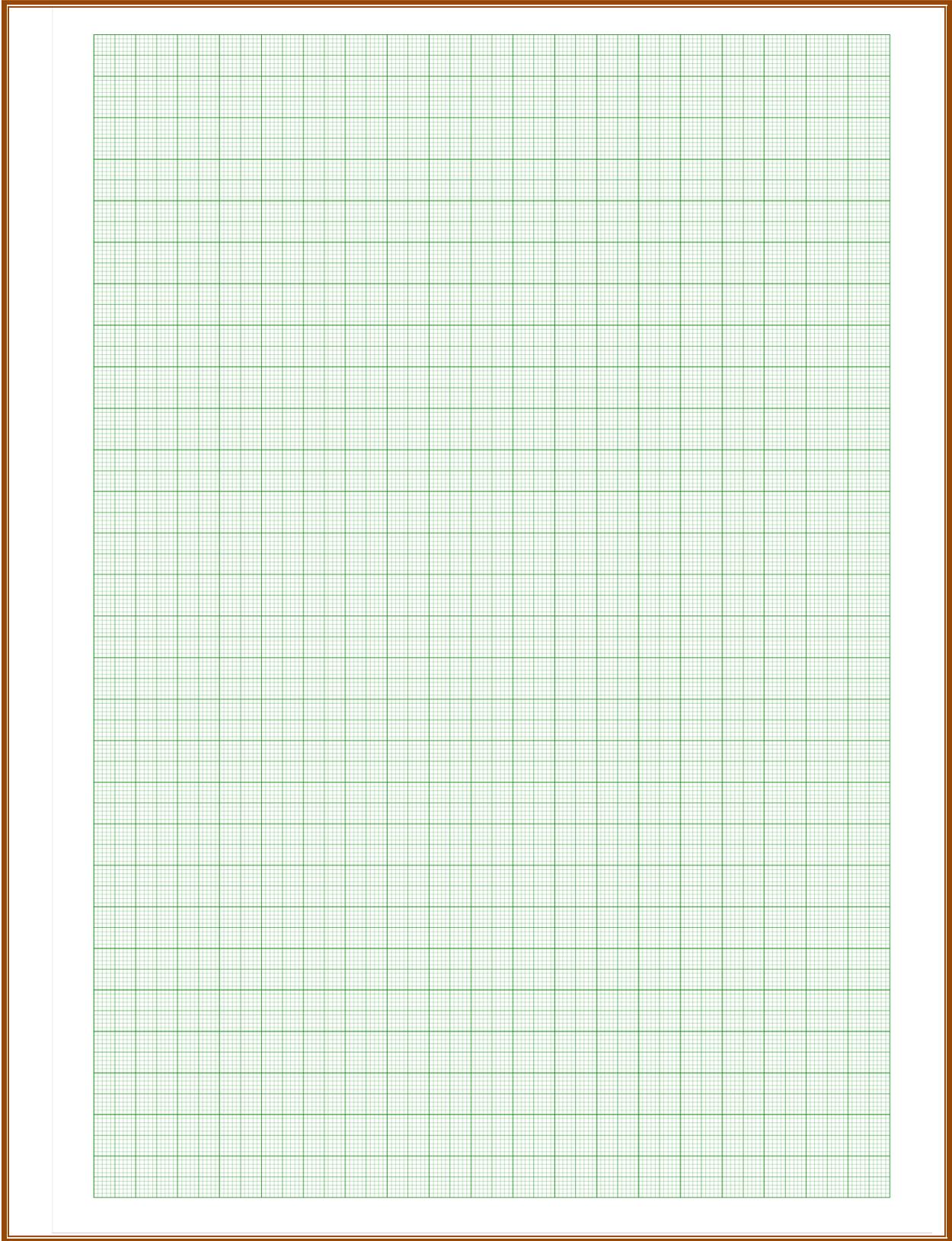
Result:

1. Hall Coefficient (R_H) = ____ $\text{m}^3/\text{Coulombs}$
2. Carrier Concentration (n) = ____ m^{-3}
3. Mobility (μ) = _____ $\text{m}^2 \cdot \text{V}^{-1} \cdot \text{Sec}^{-1}$

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What is the Hall Effect?
2. Who discovered the Hall Effect when?
3. What is the principle of the Hall Effect?
4. Define Hall Voltage.
5. What factors does the Hall voltage depend on?
6. What is the Hall Coefficient?
7. How can the Hall Effect be used to determine the type of semiconductor (n-type or p-type)?
8. Name two applications of the Hall Effect.
9. Why does Hall voltage change sign for n-type and p-type semiconductor?
10. What is the importance of Hall Effect in magnetic field measurement?



Calculations

8. LASER

AIM: To find the wavelength of laser source using diffraction grating.

APPARATUS: Laser Source, grating, Scale and Screen.

FORMULA: $\lambda = \frac{\sin\theta}{n.N}$

Where

λ is wavelength of light

θ is angle of diffraction

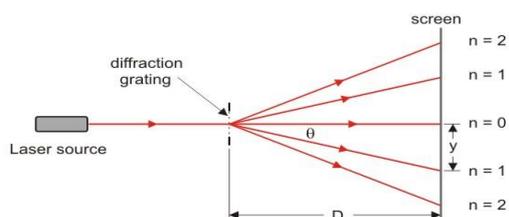
n is order of maximum

N is number of lines per centimeter on grating

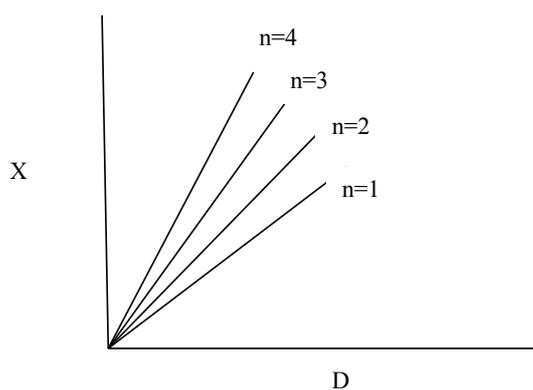
$$N = \frac{\text{No. of lines}}{\text{inch}} = \frac{\text{No. of lines}}{2.54\text{cm}} \text{ Or } \frac{2500}{2.54} = 984.25 \text{ lines/cm}$$

Units: Å or Cm

DIAGRAM:



MODEL GRAP



PROCEDURE:

The laser diode module is mounted horizontally. A diffraction grating is placed on a stand at the same height and carefully aligned for normal incidence. When the laser is switched on, a diffraction pattern appears on the screen. This pattern is traced onto a sheet of plain paper. The distances between the central maximum and the corresponding order maxima on both sides are measured and recorded. This procedure is then repeated for different values of **D** (distance between the grating and the screen).

Now plot the graph between x and D for different order of maxima. A straight line graph is obtained. The slope of the graph gives $\tan\theta$. i.e., Slope = $\tan\theta$ or $\theta = \tan^{-1}(\text{slope})$ the wavelength λ can be calculated as $\lambda = \frac{\text{Sin}\theta}{n.N}$

OBSERVATION TABLE:

S.No.	Distance between grating and screen D(cm)	Order of diffraction (n)	Distance between central maximum and corresponding maxima (x)cm		$\theta = \tan^{-1}\left(\frac{X}{D}\right)$	Sin θ	$\lambda = \frac{\text{Sin}\theta}{n.N} \text{ cm}$
			Left	Right			
1		1 2 3					
2		1 2 3					
3		1 2 3					

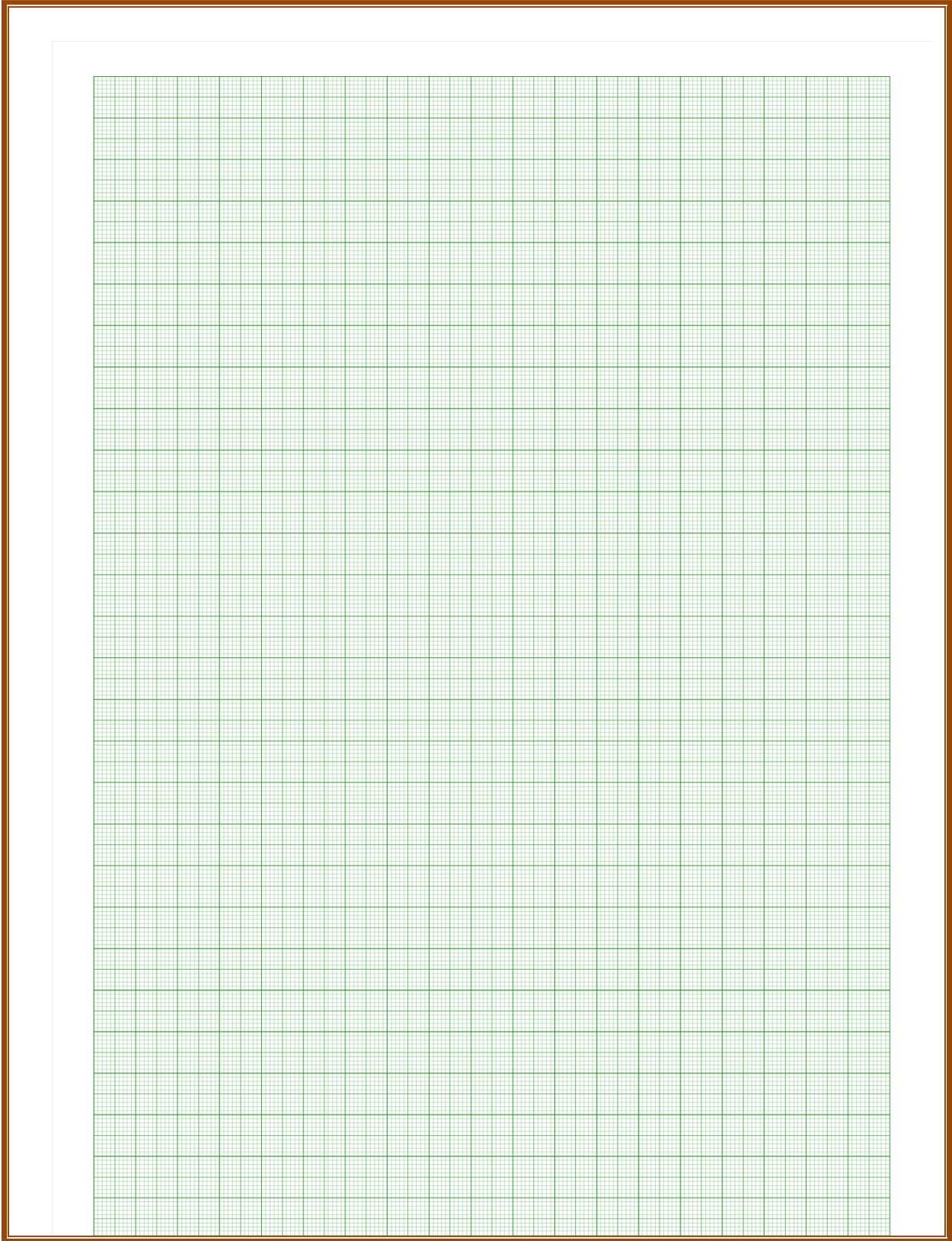
RESUTLS: The wavelength of the given laser beam is $\lambda = \dots\dots\dots \text{cm}$

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

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What does LASER stand for?
2. What is the principle of laser action?
3. What is the difference between spontaneous emission and stimulated emission?
4. What is population inversion? Why is it necessary in lasers?
5. What is the role of the optical resonator (mirrors) in a laser?
6. Give two important characteristics of laser light?
7. What is the difference between ordinary light and laser light?
8. Name two types of lasers and their active medium.
9. Mention two applications of lasers in daily life or technology.
10. Why is laser light highly monochromatic and coherent?



Calculations

9. OPTICAL FIBER

AIM: To calculate the numerical aperture and acceptance angle of an Optical Fiber.

APPARATUS: Optical Fiber Kit, few meters of Fiber Optical cable, N.A. Jig and screen.

PRINCIPLE: Total Internal reflection

FORMULA:

$$\text{Numerical Aperture} = \frac{W}{\sqrt{4L^2 + W^2}}$$

$$\text{Acceptance angle} = \alpha_m = \sin^{-1}(\text{N. A.})$$

Where

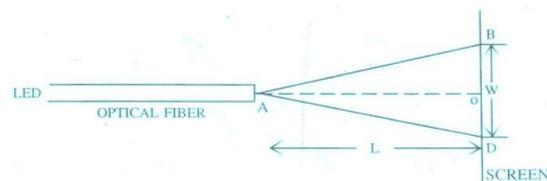
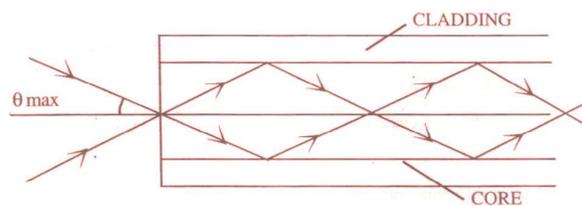
W is diameter of the Light Spot

L is distance between Jig and Screen

UNITS:

Numerical Aperture = No unit

Acceptance angle = degrees



PROCEDURE:

Insert one end of the optical fibre cable in the allotted slot of the kit until you feel that the fibre is touching the micro lens of the kit. Do not push by applying undue force that may damage the micro-lens. Gently tighten the nut that holds the insert fibre firmly. Similarly, connect the other end to the N.A. jig nut. Set the variable intensity knob for the maximum position; a red spot appears on the screen. Measure the diameter of the spot. Measure the diameter (W) of the light spot by varying the distance between the screen and jig (L) and calculate the numerical aperture and acceptance angle for the corresponding values of W and L.

OBSERVATION:

S. No.	L(mm)	W(mm)	N.A.	$\theta_i(max)$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

RESULT:

Numerical Aperture (N.A) = -----

Acceptance angle $\theta_i(max)$ = -----

Teacher's Signature

SAMPLE VIVA QUESTIONS:

1. What is an optical fiber?
2. What principle does an optical fiber work on?
3. What is total internal reflection (TIR)?
4. What are the main parts of an optical fiber?
5. Differentiate between step-index and graded-index optical fibers.
6. What is numerical aperture (NA) in optical fibers?
7. What is acceptance angle in optical fibers?
8. What are the main advantages of optical fiber communication?
9. What is attenuation (loss) in optical fibers?
10. Mention two applications of optical fibers.

10. NEWTON'S RINGS

AIM: To determine the wavelength of sodium light by using Newton's Rings.

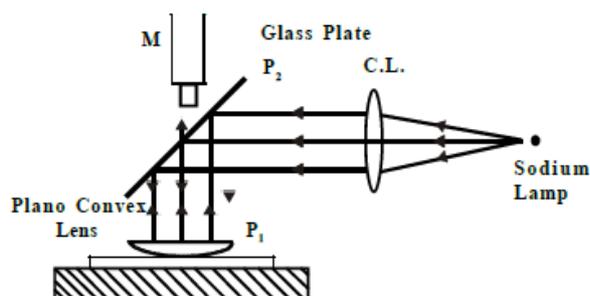
APPARATUS: Sodium lamp, condensing lens, Plano convex lens of 100cm focal length, plane glass plate, travelling microscope and a thin optically flat glass plate.

PRINCIPLE: Interference

FORMULA:

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

Where D_m and D_n be the diameters of the m^{th} and n^{th} dark rings respectively and R the radius of curvature of the lower face of the lens, then the wavelength of the light is given by the relation.



$$R = \frac{l^2}{6h} + \frac{h}{2}$$

Where

l = average distance between two legs of spherometer

i.e. $(l_1 + l_2 + l_3)/3$

h = height of the curve surface of the lens

ADJUSTMENT :

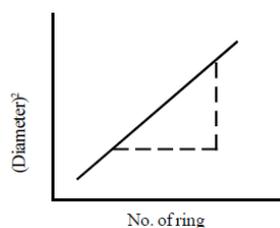
The microscope is made vertical. The eye piece is adjusted such that the cross wires are clearly seen. If necessary the cross wires are adjusted such that one of the wires is perpendicular to the direction of motion of the microscope. A mark is made on the table. The microscope is moved up or down such that the mark is seen clearly. A black paper(carbon paper) is placed on the table and a thin optically flat glass plate is placed on it. Light rays from a sodium vapour lamp are made to be incident normally on this plate with the help of a thin glass plate held at 45° . Some of the rays incident on the horizontal plate get reflected from its upper surface. These rays pass through the inclined plate and enter the microscope. When seen through the microscope, we get a bright yellow field of view. A plano convex lens is placed on the horizontal plate such that its centre is exactly below the microscope. A number of concentric dark and bright circles are seen. The microscope is finally adjusted such that the rings are clearly seen. The central spot should be dark. If the central spot is bright the lens is cleaned or it is tapped slightly. The experimental setup is shown in the diagram.

PROCEDURE : The setup is adjusted such that the intersection of the cross wires is at the centre of the central spot. The microscope is moved towards left, counting the number of rings, say upto 10^{th} ring. There after moving back the microscope the cross wire is set tangentially to the 10^{th} ring at the middle of it. The reading on the horizontal scale and the vernier coincidence are accurately noted. The reading of the 9^{th} , 8^{th} , 7^{th} ,..... 1^{st} ring are noted. The microscope is thereafter moved in the same direction till 10^{th} ring is reached on the right side and thus the readings are recorded. The diameters of different rings are noted from the differences between the corresponding readings on the right and the left side. The difference in the squares of the diameters of the rings is found. It is found to be almost constant. The lens is removed and the radius of curvature 'R' of the surface in contact with the plane glass plate is accurately measured using a spherometer. The wavelength of the light can be calculated using.

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

A graph is plotted between the number of the rings and square of its diameter. A straight line graph is obtained. Its slope is found out. The wavelength of the light can be calculated from

$$\lambda = \frac{\text{Slope}}{4R}$$



OBSERVATIONS : Least count of the travelling microscope =

Sl. No	No. of Rings	Microscope Readings		Diameter 'D'	D ²	D _m ² - D _n ² if m-n=5	$\lambda = \frac{D_m^2 - D_n^2}{4R(m - n)}$
		On Left Side	On Right Side				
	10						
	9						
	8						
	7						
	6						
	5						
	4						
	2						
	1						

Least count of the spherometer.....

Radius of curvature of the surface of the lens in contact with glass plate R.....cm

$$R = \frac{l^2}{6h} + \frac{h}{2}$$

RESULT : The wavelength of the sodium light $\lambda = \dots\dots\dots$ cm or Å

Teacher's Signature

SAMPLE VIVA QUESTIONS :

1. What is principle involved in Newton's rings.
2. What is interference?
3. What is the condition for interference maximum?
4. What is the condition for interference minimum?
5. Why Newton's rings are circular.
6. Under what condition the central spot is bright.
7. Under what condition the central spot is dark.
8. If white light is used what kind of rings are obtained
9. What are applications of Newton's rings?
10. Mention the applications of Interference?



Calculations