



**SOMAIYA**

VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering

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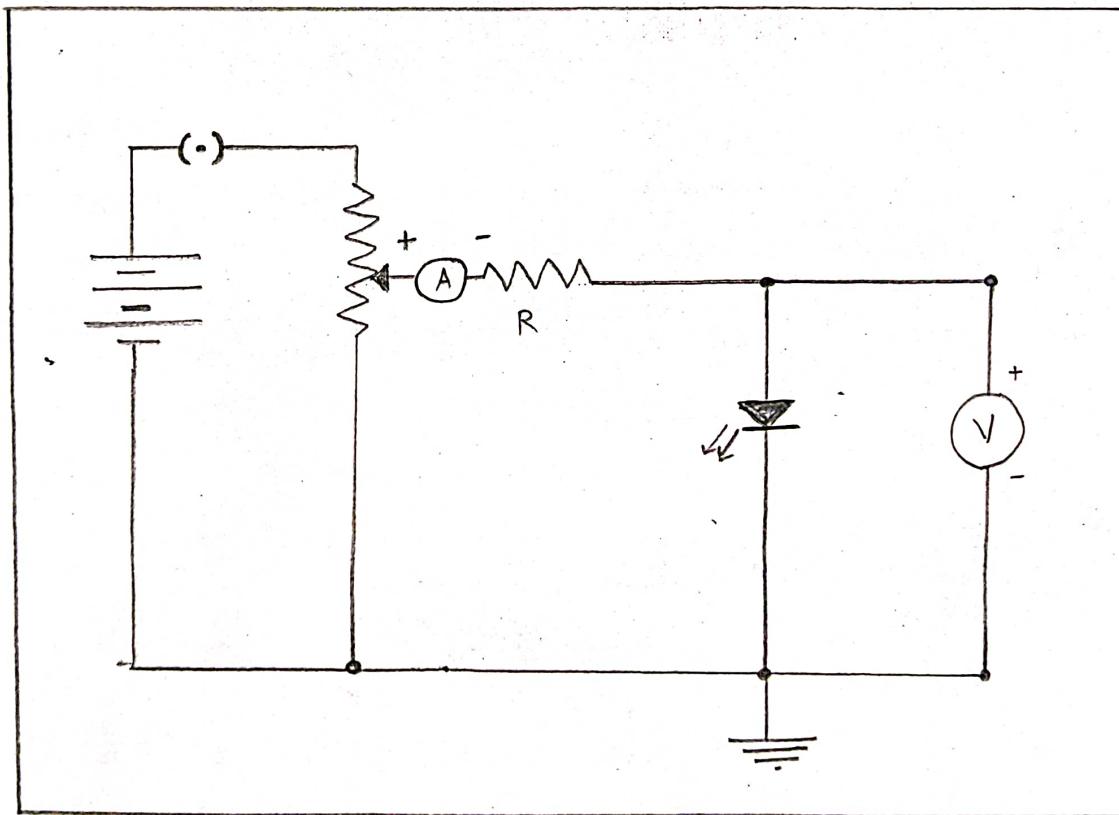
Experiment performed on (date): 23/11/23

**Title of the Experiment:** Planck's constant

**Aim:** To determine value of Planck's constant using LEDs of different colours.

**Apparatus:** Power supply , rheostat , milliammeter, voltmeter, 1K resistor , values LEDs .

**Diagram:**





### Observations:

Sr No.	LED	Wavelength $\lambda$ (nm)	$1/\lambda$ (nm $^{-1}$ )	$V_{th}$ (Volt)
1	Red	650	$1.53 \times 10^{-3}$	1.908
2	Yellow	570	$1.75 \times 10^{-3}$	2.178
3	Green	510	$1.96 \times 10^{-3}$	2.434
4	IR	1094	$9.14 \times 10^{-3}$	1.121
5	Blue	469	$2.13 \times 10^{-3}$	2.615

### Calculations:

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

$$= \frac{2.178 - 1.908}{1.75 - 1.53}$$

$$\text{Slope} = 1.227 \times 10^{-6}$$

$$h = \text{slope} \times \frac{e}{c}$$

$$= \frac{1227 \times 1.6 \times 10^{-19}}{3 \times 10^8}$$

$$= 6.544 \times 10^{-25}$$

$$h = 6.544 \times 10^{-34} \text{ J-s}$$

$$\lambda = \frac{hc}{E} = \frac{hc}{eV_{th}}$$

$$\lambda_{IR} = \frac{hc}{eV_{th}}$$

$$= \frac{6.54 \times 10^{-25} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 1.121}$$

$$= 1096 \text{ nm}$$

$$\lambda_{Blue} = \frac{6.54 \times 10^{-25} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 2.615}$$

$$= 469 \text{ nm}$$

**Result/s and Conclusion/s:** Value of Planck's constant ( $h$ ) =  $6.544 \times 10^{-34} \text{ J-s}$   
 Wavelength of IR LED = 1096 nm  
 Wavelength of Blue LED = 469 nm

$\frac{1}{\lambda} \text{ (nm}^{-1})$

0.00 0.01 0.02 0.03

0.04 0.05 0.06 0.07

0.08 0.09 0.10 0.11

0.05

0.10

0.15

0.20

0.25

0.30

0.35

0.40

0.45

0.50





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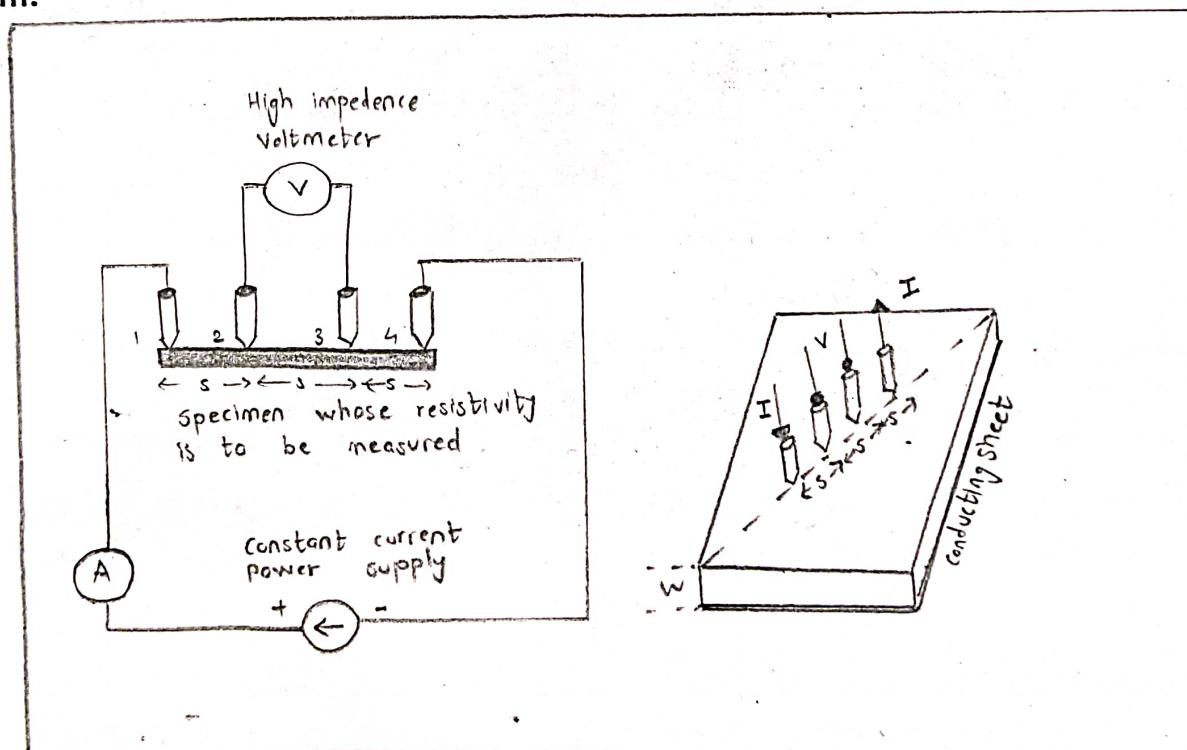
Experiment performed on (date): 23/11/23

Title of the Experiment: Resistivity by 4-Probe Method

Aim: To determine energy band gap of semiconductors by four probe method using temperature dependence of resistivity.

Apparatus: Probe arrangement, sample, oven 0-200°C, constant current generator, oven power supply and digital panel meter (measuring voltage and current)

Diagram:





### Observations:

Material : Germanium

Constant current  $I = 101 \text{ mA}$

Temperature (T) °C	Temperature (T) K	Voltage (V) mV	Resistivity (ρ) (Ω m)	$\ln(\rho)$	$\frac{1}{T} (\text{K}^{-1})$
25	298	2937	0.061	-2.79	$3.35 \times 10^{-3}$
30	303	2850	0.060	-2.81	$3.30 \times 10^{-3}$
35	308	2768	0.058	-2.84	$3.24 \times 10^{-3}$
40	313	2691	0.056	-2.88	$3.19 \times 10^{-3}$
45	318	2618	0.055	-2.9	$3.14 \times 10^{-3}$
50	323	2550	0.053	-2.93	$3.09 \times 10^{-3}$
55	328	2485	0.052	-2.95	$3.04 \times 10^{-3}$
60	333	2424	0.051	-2.97	$3.00 \times 10^{-3}$
65	338	2336	0.049	-3.01	$2.95 \times 10^{-3}$
70	343	2311	0.048	-3.03	$2.91 \times 10^{-3}$

### Calculations:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1} \\ = 548.4$$

$$\rho = 2.13 \times 10^{-3} \frac{\text{V}}{\text{I}} \\ = 2.13 \times 10^{-3} \times \left( \frac{2937}{101} \right)$$

$$\rho = 0.061$$

$$\text{Band gap } (E_g) = K \times |\text{slope}| \\ = 1.38 \times 10^{-23} \times 548 \\ = 7.56 \times 10^{-21} \text{ J} \\ = 0.047 \text{ eV}$$

**Result/s and Conclusion/s:** Energy band gap of semiconductor  
 $(E_g) = 0.047 \text{ eV}$

Scale

On X axis

3 cm = 0.1 units

On Y axis

3 cm = 0.05 units



( $\times 10^{-3}$ )

0.0

0.6

1.2

1.8

2.4

Y

0.50

0.40

0.30

0.20

0.10

X

Y

Z

W

V

U

T

S

R

P

M

L

K

J

I

H

G

F

E

D

C

B

A

0

-1

-2

-3

-4

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