Date.
Page No.

Experiment - 7

Aim :- To determine the resistivity of Semiconductor by four probe method.

Apparatus Required : probe arrangment, sample, own 0-2°C constant current generator, own power.

Theory :- At a constant temp. the resistance, R of a conductor is $\propto$ to its length l and inversly $\propto$ to its area of cross section A.

$$R = \rho \frac{L}{A} \quad \text{———} \quad (1)$$

Where ρ is resistivity of conductor and its unit is ohm meter. A Semiconductor has electrical conductivity intermediate in magnitude b/w that of a conductor & insulator. Semi Conductor differ from mental in their characteristics property of decreasing electrical resitivity with increasing temperature.

According to band theory the energy levels of Semiconductor can be grouped into two bands, valance band & the Conduction band.

In the presence of an external electric field it is electrons in valance band that can move freely thereby responsible for the electrical Conduicity of Semiconductor.
In case of intrinsic Semiconductor the fermic level lies in b/w conduction band minimum & valance band maximum.

Since, Conduction band lies above the Fermic level at 0, when no thermal excitation are available so conduction is not possible at 0k.
As temperature increase the occupancy of Conductor band goes up, thereby resulting in decrease of electrical resistivity of Semiconductor

$$\rho = \frac{\rho_0}{f\left(\frac{W}{S}\right)} \quad \text{——— (2)}$$

f (W/S) is a devision for Computing resistivity which depends on value of w & S.

$$\rho_0 = \frac{V}{I} \times 2\pi S \quad \text{—— (3)}$$

Where, V = potential difference
I = current
S = Spacing b/w probes.

Applications:-

1. Remote Sensing areas.
2. Resistance thermometer.
3. Induction harding process.
4. Accurate geometry factor estimation.
5. characterisation of fuel cells. bipolar plates.

Observation Table:-

Temperature	Voltage	Current	Resistivity
30	0.1693	6	6.0172
35	0.1644	6	5.8444
40	0.1599	6	5.6819
45	0.1556	6	5.5288
50	0.1515	6	5.3843
55	0.1477	6	5.2479
60	0.1440	6	5.1189
65	0.1406	6	4~~8~~·9969
70	0.1376	6	4.8809
75	0.1342	6	4.9910
80	0.1313	6	4.6665

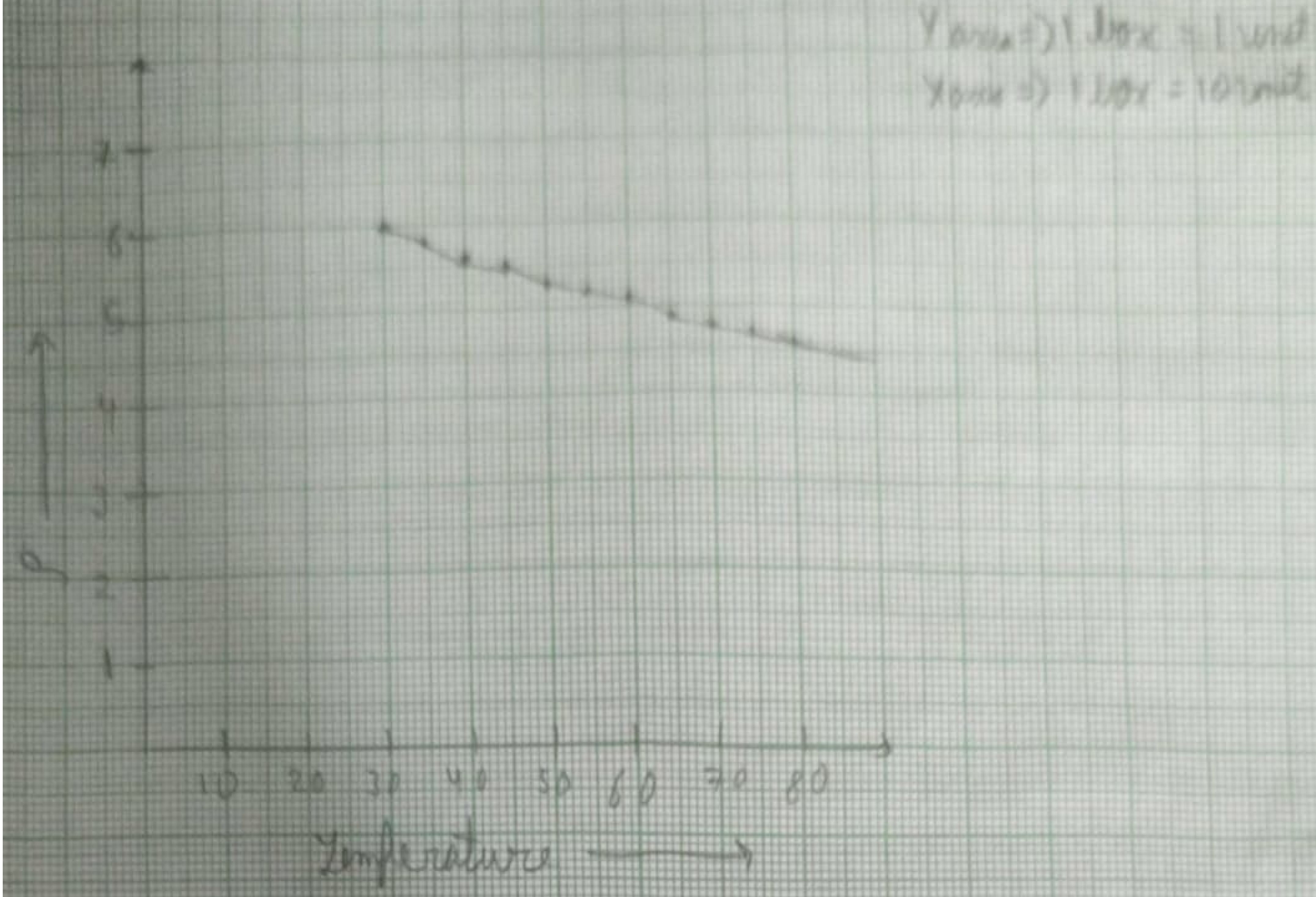
Calculations:-

Distance b/w probes S as 0.2cm & thickness of sample was 0.05cm.

From standard table $F(w/s) = 5.89$

$$\rho_0 = \frac{V}{I} \times 2\pi S = \frac{0.1693}{6} \times 2 \times 3.14 \times 0.2$$

$$\rho_0 = 35.4$$



Y axis => 1 box = 1 unit
X axis => 1 box = 10 unit
1
2
3
4
5
6
7
10
20
30
40
50
60
70
80
Temperature

Date.
Page No.

$$\rho = \frac{\rho_0}{F(W/S)} = \frac{35.4}{5.89} = 6.0172 \text{ ohm cm.}$$

Similarly for all

for $T = 80$

$$\rho_0 = \frac{V}{I} \times 2\pi S = \frac{0.1313}{6} \times 2 \times 3.14 \times 0.2$$

$$\rho_0 = 27.4$$

$$\rho = \frac{\rho_0}{F(W/S)} = \frac{27.4}{5.89} = 4.6665 \text{ ohm cm}$$

Result:- The resistivity of given semiconduct by your probe method = 5.2853 ohm cm

Note:- The resistivity written in result is the mean of resistivites of different temperature.