DEPARTMENT OF PHYSICS AND NANOTECHNOLOGY
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

Module IV & Lecture 4

Problem 1:

Compute the resistivity of the given material whose resistance is 2Ω; area of cross-section and length are 25cm^2 and 15cm respectively?

Answer:

Given

R = 2Ω

l = 15cm = 0.15m

A = 25cm^2 = 0.25m^2

Resistivity formula is

$$\rho = \frac{RA}{l} \qquad \rho = \frac{2 \times 0.25}{0.15} = 3.333\Omega m$$

Problem 2:

The length and area of wire are given as 0.2 m and 0.5 m^2 respectively. The resistance of that wire is 3 Ω, Calculate the resistivity?

Ans: 7.5 Ωm

Problem 3:

Calculate the resistivity of a rectangular Germanium crystal of area S= 100 cm^2 connected through Four probe if a current of 2 mA passed through it generates a voltage of 180 mV at 35 ^0C.

$\rho = (V/I) \times 2\pi S$

$= (180/2) \times 2 \times 3.14 \times 10^{-2}$

$= 565.2 \times 10^{-2} = 5.652\ \Omega \cdot m$

4. A silicon plate of thickness 1 mm, breath 10mm and length 100mm is placed in a magnetic field of 0.5 Wb/m^2 acting perpendicular to its thickness. If 10^{-2} A current flows along its length, calculate the Hall voltage developed if the Hall coefficient is 3.66×10^{-4} m^3 / coulomb.

Given Data:

t= 1mm; w= 10mm ; L = 100 mm ; B = 0.5 Wb/m^2 ; I = 10^{-2} A ; $R_H = 3.66 \times 10^{-4}$ m^3 / coulomb.

Solution:

Hall coefficient $R = V_H t / IB$

$V_H = R_H IB/t$

$= 3.66 \times 10^{-4} \times 10^{-2} \times 0.5 / 1 \times 10^3$

$= 1.83 \times 10^{-3}$ V = 1.83 mV

Exercise:

1. A semiconducting crystal 12mm long, 5mm wide and 1mm thick has a magnetic flux density of 0.5 Wb/m2 applied from front to back perpendicular to largest faces.When a current of 20mA flows lengthwise through the specimen , the voltage measured across its width is found to be 37 μV . What is the Hall coefficient of this semiconductor? Ans: $R_H = 3.7X\ 10^{-6}\ C^{-1}m^3$

2. A n-type semiconductor has Hall coefficient = 4.16 x10 $^{-4}$ m^3c^{-1}. The conductivity is 10^8 $ohm^{-1}m^{-1}$. Calculate its charge carrier density ne and electron mobility at room temperature.

Ans : n_e = 1.77 x 10^{-22} m^{-3} ; $\mu_e = 0.0038 m^2v^{-1}s^{-1}$