**Department of Science and Humanities**

F Y B Tech SEM II 2021-22

Engineering Physics Lab Course

**Measurement of resistivity by 4-probe method**

**Name: Pargat Singh**

**Roll No: 16010121045**

**Branch: COMPS**

**Batch: A2**

**Aim:** To determine the Energy Band Gap of Semiconductor

**Apparatus:**

* Container
* P-N Diode
* Battery
* Voltmeter
* Ammeter
* Thermometer

**Diagram:**

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**Observation Table:**

Material: Germanium

Constant current = 10 mA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Temperature(T) K | Voltage(V) mV | Current(I) mA | Resistivity\*(ρ) (Ω-m) | In(ρ) | $\frac{1}{T}$ (K-1) |
| 298 (RT) | 290.8 | 10 | 6.35 x 10-2 | -2.76 | 0.336 x 10-2 |
| 303 | 282.2 | 10 | 6.01 x 10-2 | -2.81 | 0.330 x 10-2 |
| 308 | 274.1 | 10 | 5.84 x 10-2 | -2.84 | 0.325 x 10-2 |
| 313 | 266.5 | 10 | 5.68 x 10-2 | -2.87 | 0.320 x 10-2 |
| 318 | 259.3 | 10 | 5.52 x 10-2 | -2.90 | 0.315 x 10-2 |
| 328 | 252.5 | 10 | 5.38 x 10-2 | -2.92 | 0.305 x 10-2 |
| 333 | 246.1 | 10 | 5.24 x 10-2 | -2.94 | 0.300 x 10-2 |
| 338 | 240.0 | 10 | 5.11 x 10-2 | -2.97 | 0.296 x 10-2 |
| 343 | 234.3 | 10 | 4.99 x 10-2 | -3.00 | 0.292 x 10-2 |

\*With geometric correction

**Formula:** resistivity (with geometrical correction factor) at a given temperature (T)

ρ $=2.13 ×10^{-3}\frac{V}{I}$

**Home Assignment:**

Plot a graph of ln(ρ) (Y-axis) v/s 1/T (X-axis). Determine its slope.



Calculate energy band gap using the formula: $E\_{g}=2k×slope$; where k is Boltzmann constant = 8.62 x 10-5 eV/K.

**Calculations:**

Slope = 833.33

Eg = 2 x K x slope

Where, K is Boltzmann constant = 8.62 x 10-5 eV/K.

$∴$ Eg = 2 x 8.62 x 10-5 x 833.33 eV

 = 14366 x 10-5 eV

 = 1.44 x 10- eV

**Result:**

Energy band gap of Ge = 1.44 x 10- eV.