OBJECTIVES: To Study the Energy Band Gap & Diffusion Potential of P - N Junction.

PN JUNCTION SET-UP

The set-up consists of following:

1. PN junction set up.
2. Oven with thermometer. (Display on Panel)
3. A Samples of junction transistor with connecting leads
4. Diode 1N5402 to measure junction capacitance.
5. Connecting lead to connect oscilloscope for measure junction capacitance.
6. Power Cord

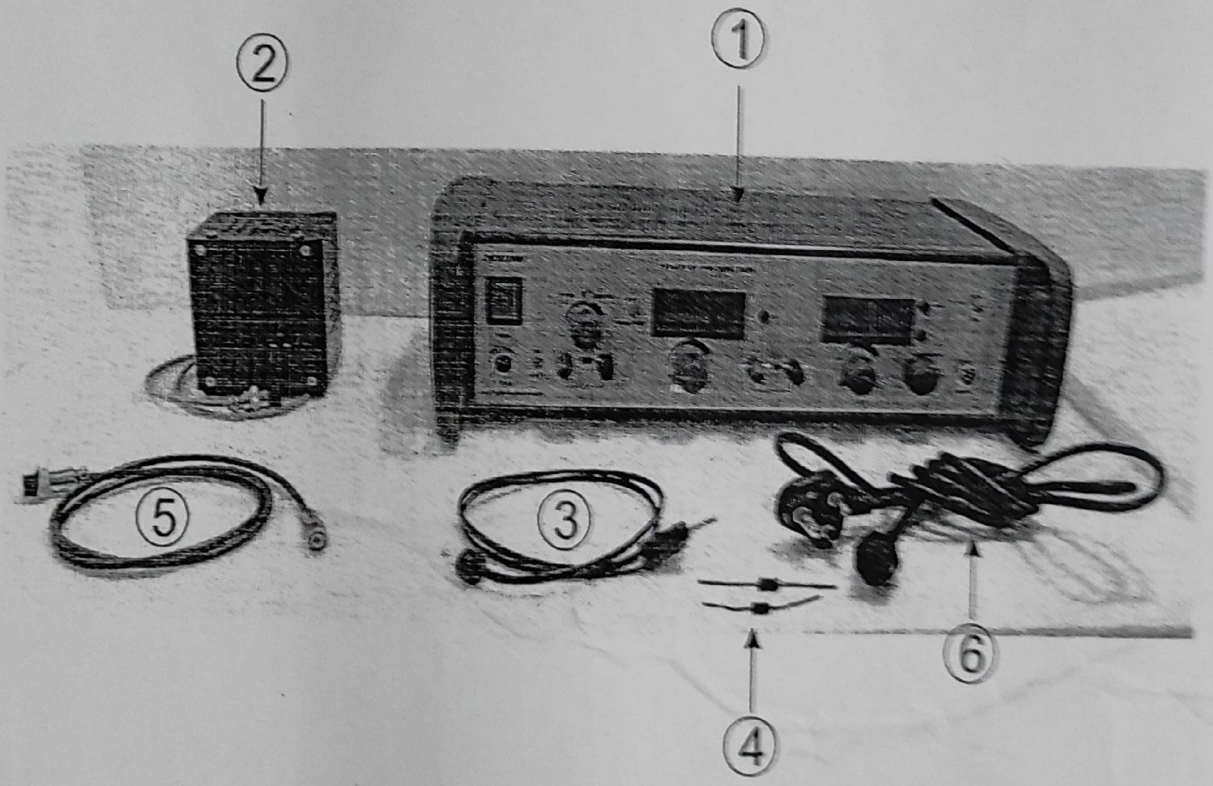

Fig. 1 : Different Components of P – N Junction Set-up

Expt: 2

EXP-1: Determination of the reverse saturation current I_0 & material constant η.

The current I in the p-n junction is given by, $I = I_O(e^{\frac{qV}{\eta kT}} - 1)$ .....(1)

where, q = electronic charge = 1.602×10^{-19} Coulomb

η = material constant = 1 for Ge

= 2 for Si

k = Boltzman's constant = 1.38×10^{-23} J/K

T = Temperature in Kelvin

V = Junction voltage in Volt.

The reverse saturation current is usually too small to measure directly. An indirect graphical method may be obtained by taking logarithm of equation (1) for $e^{\frac{qV}{\eta kT}} \gg 1$ as,

$$\ln I = \ln I_0 + \frac{qV}{\eta kT} \quad \text{.....(2)}$$

If V & $\ln I$ are plotted on graph paper a straight line is obtained. This line intersects the current ($\ln I$) axis at $\ln I_0$ & its slope may be solved to compute η,

$$\eta = \frac{q \Delta V}{kT \Delta \ln I} \quad \text{.....(3)}$$

Note the junction voltage by varying the current source. The values of junction voltage & current are displayed on the panel display provided on the setup.

PROCEDURE:

- Connect the PN junction set up to the ac mains. Ensure that the oven switch is off.
- Connect the junction transistor lead to the 'Junction Terminals' provided on the setup as polarity indicated on it.
- Keep the Left Hand Side Digital Display in "Junction Mode."
- Keep the Right Hand Side Digital Display in "Current Mode"
- Switch on the PN junction set up.
- Vary the Junction Voltage Knob and obtain current as a function of junction voltage.
- Determine the material constant η.

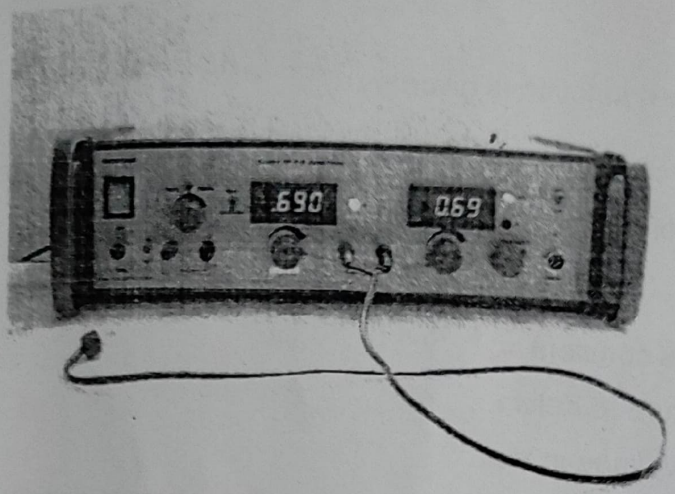

Fig. 2 : Study of *I-V* Characteristics of Sample BC 109 in Forward Bias

SAMPLE DATA: BC 109

S.No	Voltage, *V* (Volt)	Current, *I* (mA)	ln *I*
1	0.312	0.03	-3.507
2	0.500	0.10	-2.303
3	0.576	0.20	-1.609
4	0.624	0.30	-1.204
5	0.650	0.50	-0.693
6	0.664	0.69	-0.371
7	0.678	0.97	-0.030
8	0.687	1.20	0.182
9	0.694	1.44	0.365
10	0.703	1.81	0.593
11	0.711	2.24	0.806
12	0.727	3.50	1.253
13	0.736	4.54	1.513
14	0.752	7.09	1.959
15	0.764	9.78	2.280
16	0.772	12.40	2.518
17	0.775	13.61	2.611

ANALYSIS

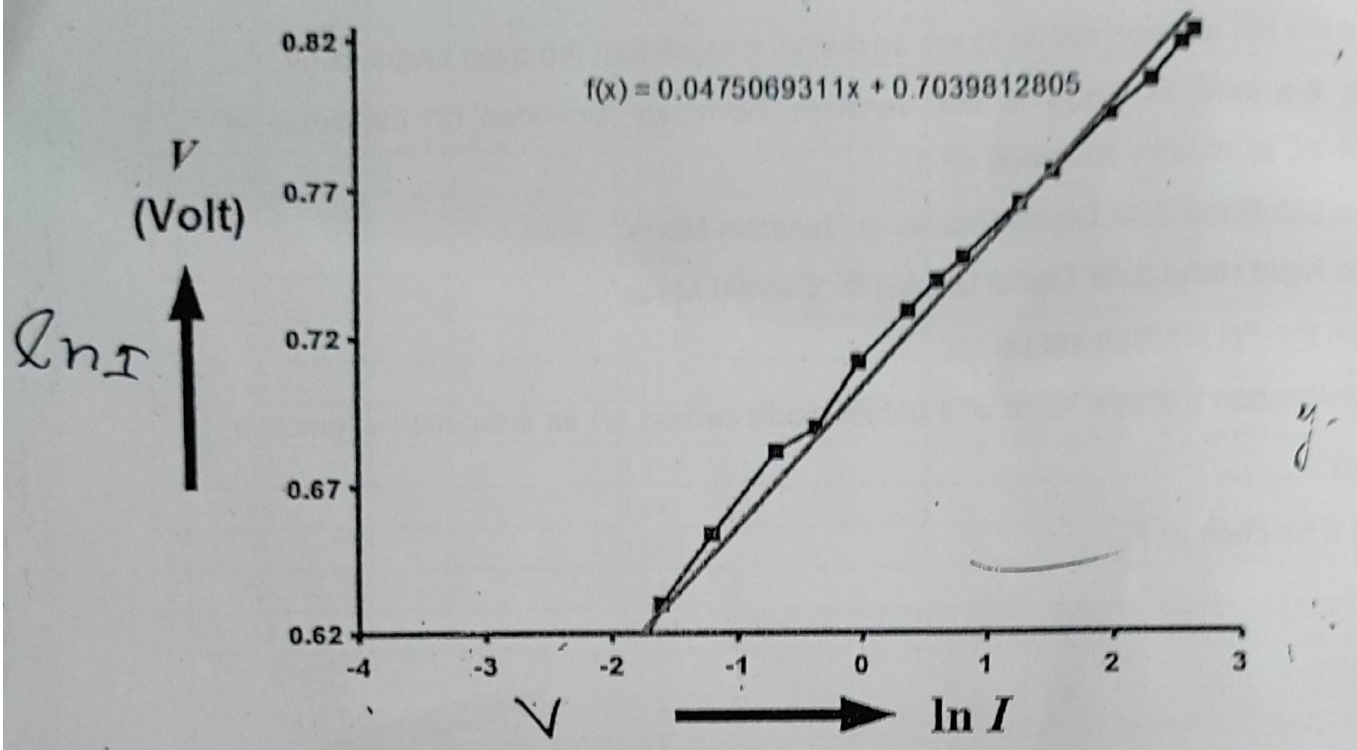

Fig. 3 : Graphical Representation of Variation of V as a Function of $\ln I$ of Sample BC 109

Slope = $\frac{\Delta V}{\Delta \ln I}$ = 0.0475

Therefore, $\eta = \frac{q\Delta V}{kT\Delta \ln I}$ = 1.81 at T = 303 K

EXP-2: Forward Bias Characteristics of Junction Diode (IN5402)

PROCEDURE:

- Connect the PN junction set up to the ac mains. Ensure that the oven switch is off.
- Connect the junction diode to the 'Junction Terminals' provided on the setup in forward bias as polarity indicated on it.
- Keep the Left Hand Side Digital Display in "Junction Mode."
- Keep the Right Hand Side Digital Display in "Current Mode"
- Switch on the PN junction set up.
- Vary the Junction Voltage Knob and obtain diode current (I) as a function of junction voltage (V).
- Plot I as a function of V.

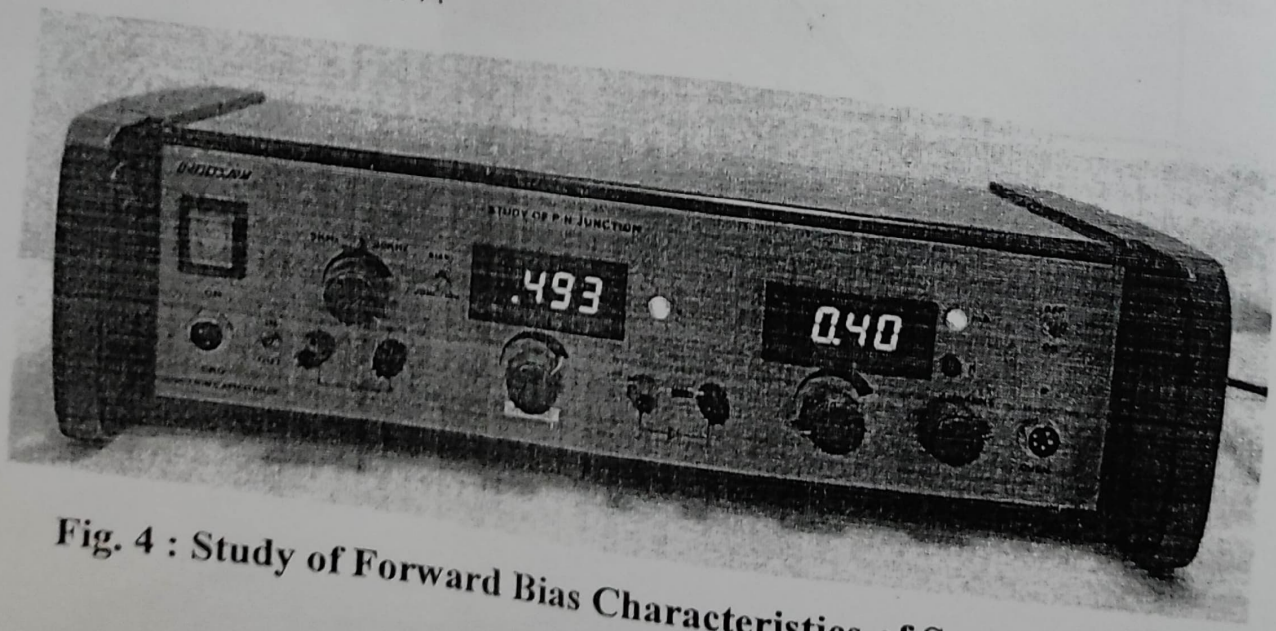

Fig. 4 : Study of Forward Bias Characteristics of Sample IN5402

SAMPLE DATA: IN5402

S. No.	Voltage, V (Volt)	Current, I (mA)
1	0.000	0.00
2	0.493	0.4
3	0.532	1.00
4	0.564	2.00
5	0.582	3.00
6	0.595	4.00
7	0.604	4.87
8	0.606	5.00
9	0.614	6.00
10	0.621	7.00
11	0.627	8.00
12	0.632	9.00
13	0.637	10.00
14	0.642	11.00
15	0.645	12.00
16	0.649	13.00
17	0.651	13.61

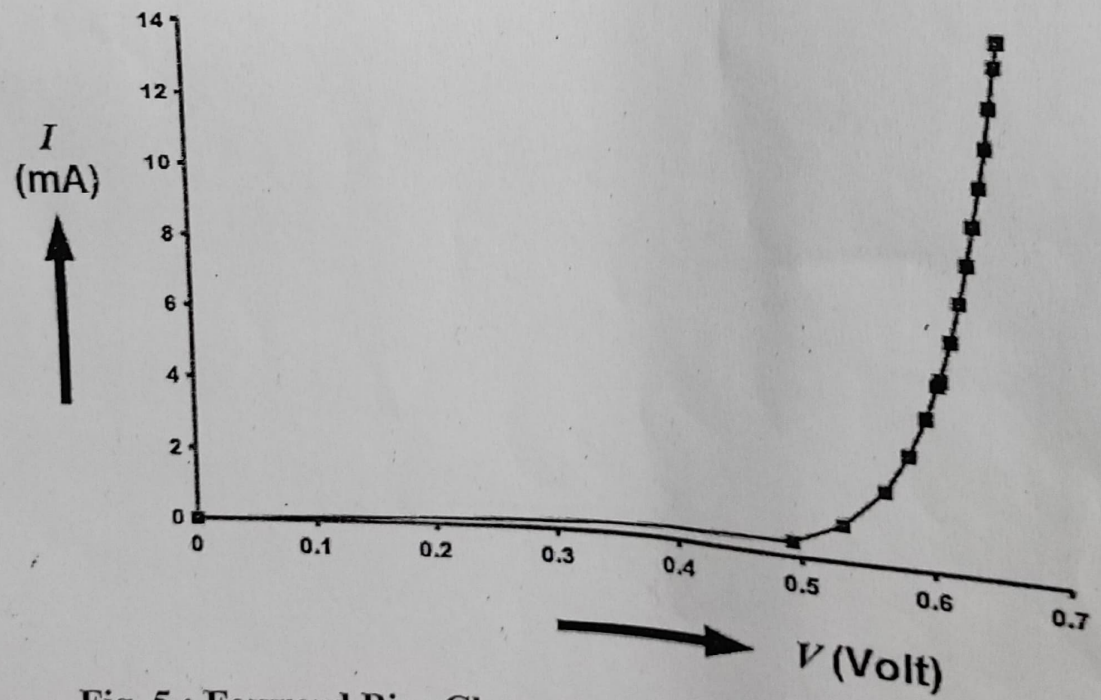

Fig. 5 : Forward Bias Characteristics of Sample IN5402

Knee Voltage = 0.58 Volt