Name of experiment:

Observation of the V-I characteristic of a diode.

Objective:

To see the Voltage-Current relation in Diodes by applying a voltage across it and measuring the corresponding current flowing through it.

Theory:

A semiconductor is a solid material whose electrical resistivity is higher than that of a conductor and lower than that of an insulator. Typical values of the resistivity of a semiconductor lie between 10^{-2} and 1 ohm-m at room temperature. The electrical conductivity of a semiconductor can be increased by a large value by addition of small amount of suitable impurity.

If one side of a single crystal of semiconductor metals is doped with acceptor impurity atoms and the other side of the same

crystal is doped with donor impurity atoms, a PN junction is formed.

The diode is a device formed from a junction of n-type and p-type semiconduction material. The lead connected to the p-type material is called the anode and the lead connected to the n-type material is the cathode. In general, the cathode of a diode is marked by a solid line on the diode.

So, it can be said that, a PN- junction provided with copper wire connecting leads, which rectifies current, becomes an electronic device is known as a diode. which is also be called as a specialized electronic component with two electrodes called the anode and the cathode. Diodes can be used as rectifiers, signal limiters, voltage reg-

ulators, switches, signal modulator, signal mixers, signal demodulators and oscillators.

There are several types of diodes are available for use in electronics design. Some are given below:

PN junction diode: The standard PN junction may be thought of as the normal or standard type of diode in use today. These diodes can come as small signal types for use in RF (radio frequency), or other low current applications which may be called as signal diodes. Other types my be planned for high voltage and high current applications and are normally named rectifier diodes.

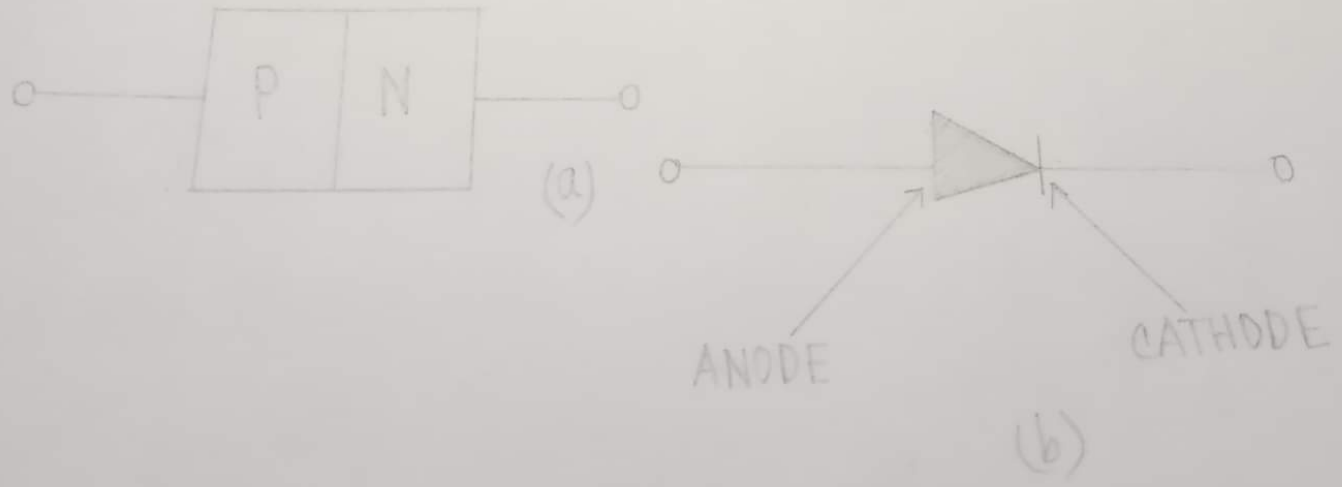
Zener diode: The zener diode is used to provide a stable reference voltage. It works under reverse bias condition and

found that when a particularc voltage is reached it breaks down.

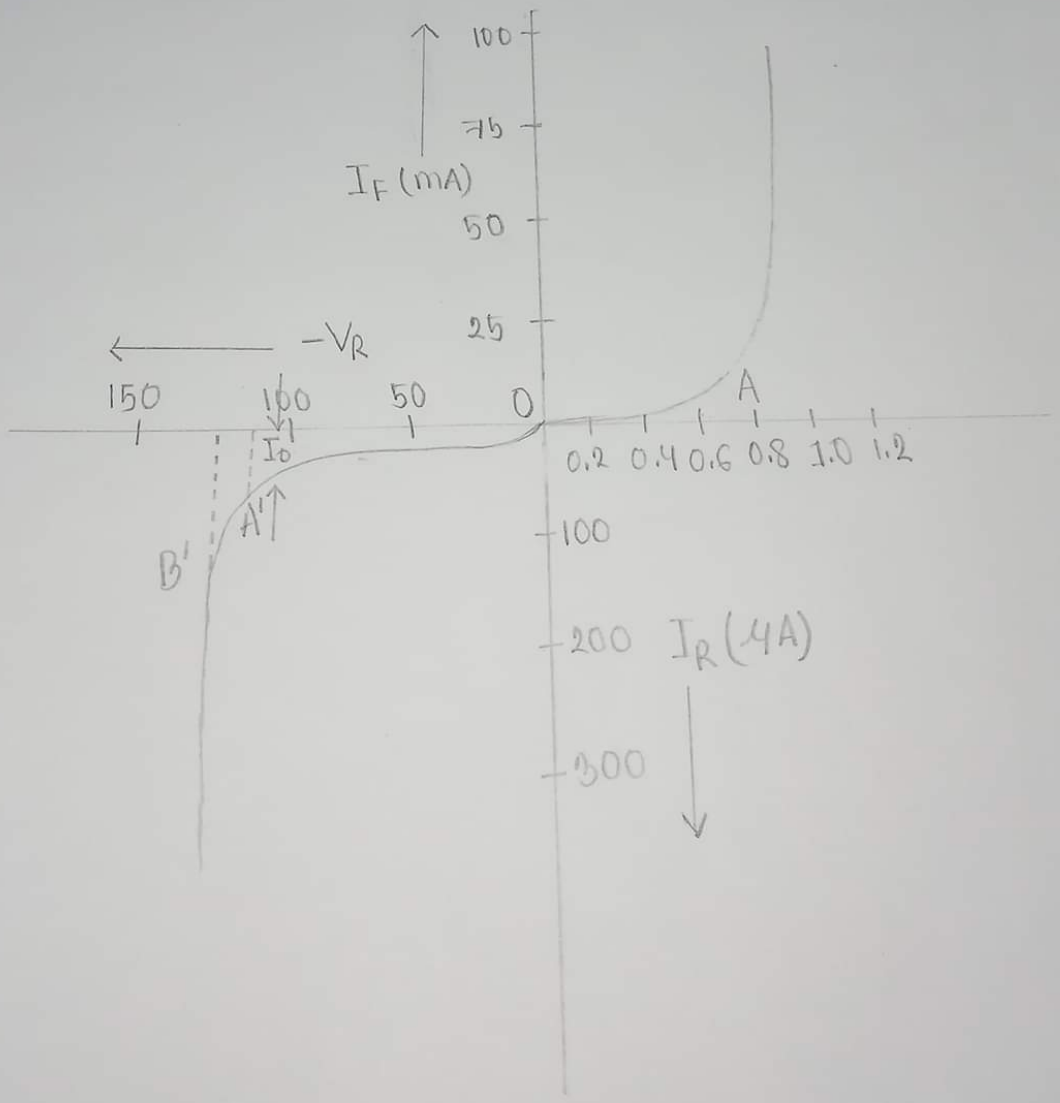
Photodiode: The photodiode is used to detect light. It is found that when light strikes a PN-junction it can creat electrons and holes.

More than diodes are available for use in electronics design, namely; a Backword diode, BARTT diode, Gunn diode, Laser diode, Light emitting diodes, PIN diode, Schottky diode, Step recovery diode. Tunnel diode etc.

The circuit symbol for a semiconductor diode is shown below:



The primary function of the diode is rectification. When it is formed forcwaard biased (the higherc potential is connected to the anode lead), it will pass curricent. When it is reversed biased (the higherc potential is connected to the cathode lead), curricent flow is blocked. A generical curve looks like this:



The current-voltage characteristic of a PN junction diode is represented theoretically by the equation

$$I = I_0 \left(e^{\frac{qv}{nkT}} - 1\right)$$

where,

I = the diode current in amperes,

I_0 = the reverse saturation current in amperes at temparature T°K.

V = the potential difference in volts; it is positive for forward and negative for reverse bias.

q = the electronic charge, 1.6×10^{-19} coul.

k = Boltzmanns constant, 1.38×10^{-23} J/°K

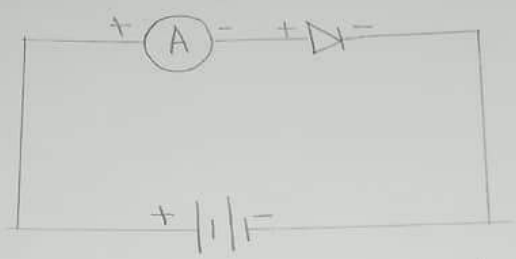
$n = 1$ for germanium diode, and 2 for silicon diode.

This equation is valid ∀ for all values of V upto the turnover voltage.

Apparatus required:

(i) diode
(ii) Power supply
(iii) Bread board
(iv) Multimeter.

Working diagram:



V-I characteristic of diode.

Procedure:

(i) First, we complete a circuit shown in working diagram.

(ii) We use power supply for variable voltage source.

(iii) We note the point ~~who~~ and gradually increase the voltage and take the corress

ponding current readings.

(iv) We have to take many readings till the input voltage is about 1.5V.

(v) We increase the voltage from 0V to 1.5V volt increasing 0.1 V correspondingly.

(vi) To get the reading of current value in reverse bias is difficult in a lab because it gives the value in micro-ampere. In this regard we skip this.

(vii) By plotting V-I curve, we will get the pictures of diode characteristic.

Result:

SL.NO	Voltage (V)	Current (mA)
1	0.1	0.0
2	0.2	0.0
3	0.3	0.0
4	0.4	0.0
5	0.5	0.02
6	0.6	0.07
7	0.7	0.08
8	0.8	0.25
9	0.9	0.354
10	1.0	0.46
11	1.1	0.81
12	1.2	1.05
13	1.3	1.36
14	1.4	2.02
15	1.5	2.36

Disaussion:

1. Some differencee may appearced between ideal curcve and the resulted plotted graph because ideal curcve is plotted accorcding to the equation theorcitically. On the otherhand, plotted curcve is according to the having practical value. As, we practically do this, therce's may happen some mistakes which make the changes.

2. We didn't do the reverse bias. If we did this, the sudden changes might destroy the diode.

3. The reverse bias measure the current in micro-ampere (μ-A). So, current must not pass through the diode for a long time. It will then increase the depletion region and develop a fluctuation resistance.

4. Due to safty issue, we just do the forward bias and observe the characteristics of

a diode practically.

Precaution:

(i) To observe the changes, we increase the voltage slowly and little by little. (0.1V)

(ii) We carefully take the current value according to the changes of voltage.

(iii) We didn't try to do the reverse bias in the lab because of some safty issue.

(iv) We attach all the apparatus according to the circuit diagram, carefully.

(v) Overall, we betake caution on every step.

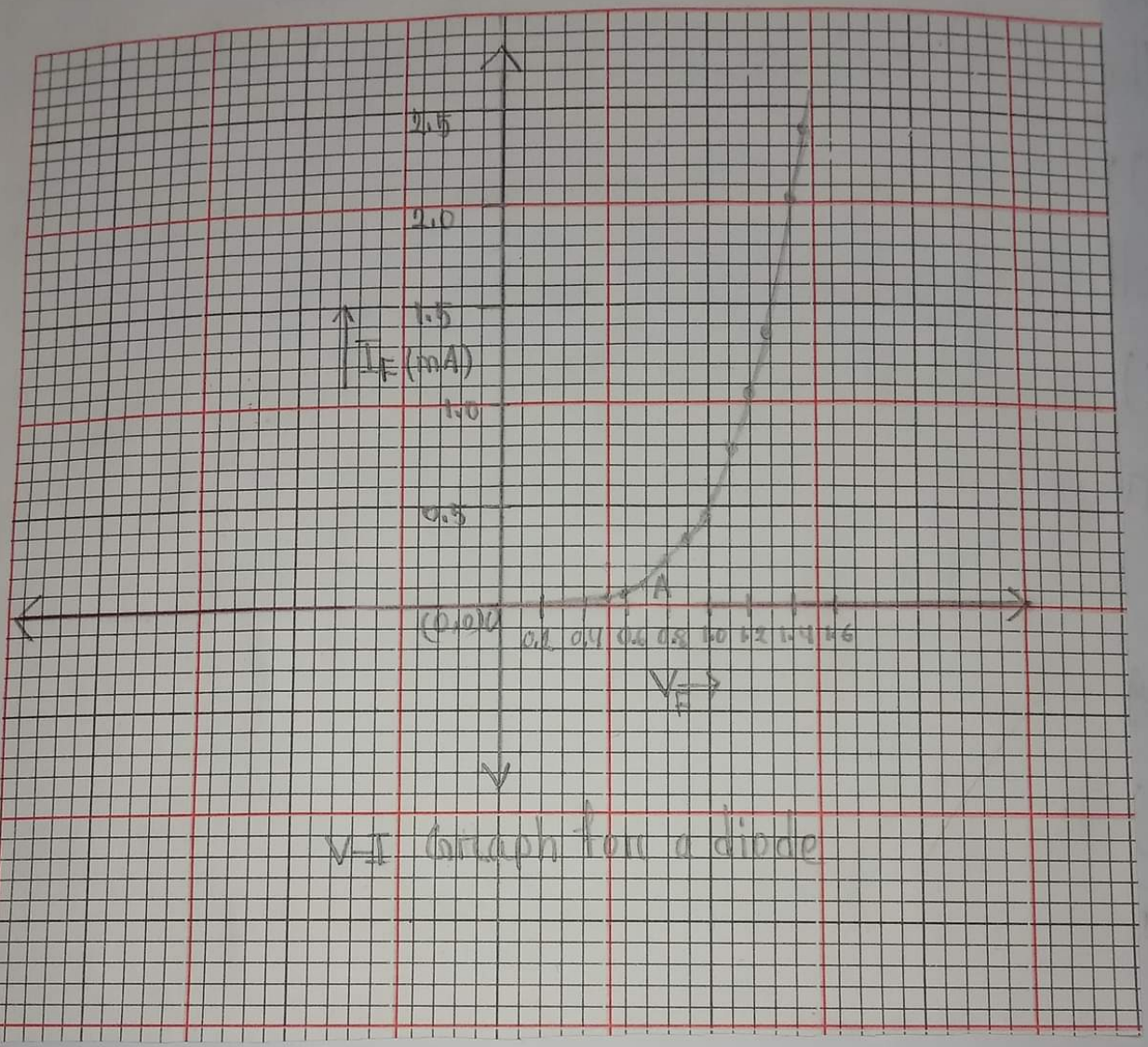
Refference:

(1) Electronic Devices and Circuits
— David A. Bell

(2) Elements of Electronics
— M.K Bagde & S.P. Singh.

(3) https://www.electronic-tutorials.ws
[Access date: 14-12-2019]

Graph:



V-I Graph for a diode