EXPERIMENT NO.3

TITLE OF THE EXPERIMENT: Study of the V-I characteristics of P-N junction diode

Objective : To plot V-I characteristics of silicon P-N junction diode.

: To find out static and dynamic resistance in forward biased condition.

: To find cut-in voltage for silicon diode in forward biased.

APPARATUS REQUIRED

1. Trainer kit.
2. Variable power supply(0-20)v DC
3. Ammeter (0-50) mA – 1 No.
4. Digital Multimeter – 2 No.
5. Silicon Diode (1N4007) – 1 No.
6. Resistor (1kΩ) – 1 No.

THEORY

Donor impurities (pentavalent) are introduced into one-side and acceptor impurities into the other side of a single crystal of an intrinsic semiconductor to form a p-n diode with a junction called depletion region (this region is depleted off the charge carriers). This region gives rise to a potential barrier called Cut-in Voltage. Above this voltage across the diode starts conducting. The P-N junction supports uni-directional current flow.

PN- JUNCTION DIODE IN FORWARD BIAS CONDITION

If +ve terminal of the input supply is connected to anode (P-side) and –ve terminal of the input supply is connected the cathode. Then diode is said to be forward biased. In this condition the height of the potential barrier at the junction is lowered by an amount equal to given forward biasing voltage.

Both the holes from p-side and electrons from n-side cross the junction simultaneously and constitute a forward current from n-side (injected minority current due to holes crossing the junction and entering P- side of the diode).

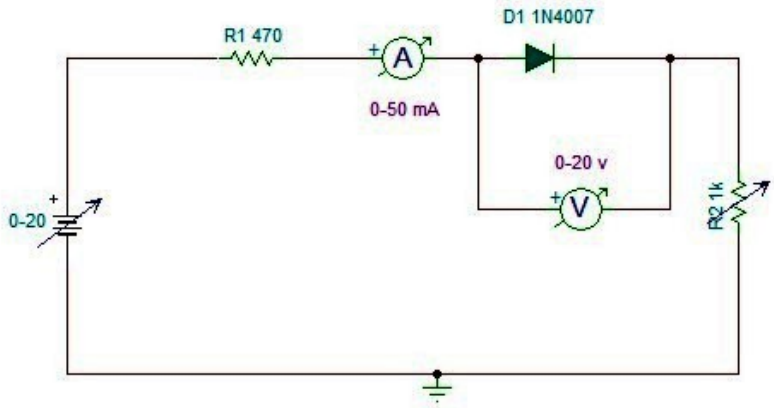

Fig: Forward bias connection of PN junction diode

Dynamic Resistance $r_d = \frac{26mv}{I_f}$

The dynamic resistance of a forward biased diode is correct only at 26° C junction temperature. For higher / lower value:

$$r_d = \frac{26mv}{I_F}\left[\frac{T + 273°C}{298°C}\right]$$

- **Static resistance** can also be calculated as

$$R_{DC} = \frac{V_{DC}}{I_{DC}}$$

DC or Static resistance

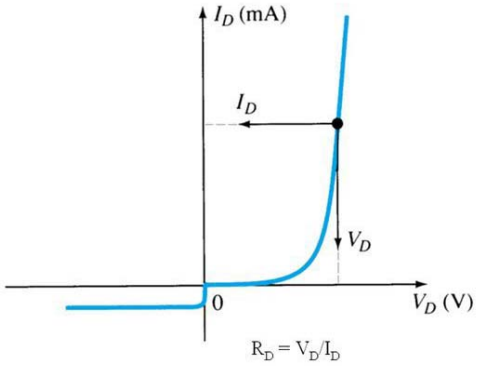

TABLE FOR FORWARD BIAS CONDITION

Supply Voltage (in Volt)	Forward Voltage across diode V_f(in Volte)	Forward Current across Diode I_f (in mA)

Calculations from Graph

Cut-in Voltage V_{cut-in}

Static forward Resistance $R_{DC} = \frac{V_{DC}}{I_{DC}} = \frac{V_f}{I_f}\ \Omega$

Dynamic Forward Resistance $r_d = \frac{\Delta V_d}{\Delta I_d} = \frac{26milivolt}{I_d}\Omega$

Conclusion:

VIVA QUESTIOS

1. What is junction diode?
2. What is meant by forward bias?
3. What is meant by reverse bias?
4. What is knee voltage?
5. What is reverse breakdown?
6. What are the semiconductor materials in use?
7. Why is Silicon used popularly compared to Germanium?
8. How many valence electrons are there in each atom of a semiconductor?
9. What are the p type doping materials and n type doping materials?
10. How many valence electrons are there in P type doping materials and in n type doping materials?
11. Draw the ideal, practical and piecewise linear characteristics of a PN junction diode.
12. What is the static resistance of a diode?
13. What is the dynamic resistance of a diode?
14. How PN junction diode does act as a switch?
15. What is cut-in voltage?
16. What are its values for Si and Ge diodes?
17. Write the Diode current Equation.