Practical No.3: Check the performance of PN Junction diode

I Practical Significance

PN Junction diode is used in industries as well as in domestic applications such as current protection circuits, wave shaping circuits and in rectifier of DC Power Supplies. For these applications diode selection plays a vital role. In this practical, students will draw V-1 characteristics of the given diode to understand diode behavior with respect to change in applied voltage.

II Industry / Employer Expected Outcome

This practical is expected to develop the following skill: **'Use electronic components and circuits in electrical equipment.'**

III Course Level Learning Outcome

Use semiconductor diodes in different applications.

IV Laboratory Learning Outcomes

Test V-I characteristics of PN Junction diode to:

1. Check PN junction Diode in forward bias.
2. Plot the V-I characteristics of PN junction diode and determine cut-in voltage.

V Relevant Affective Domain related Outcome

Handle components and equipment carefully.

VI Minimum Theoretical Background

A PN Junction Diode is one of the simplest semiconductor devices and it has the characteristic of passing current in one direction only. If suitable positive voltage (forward bias) is applied between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction, as the width of the depletion layer around the PN junction is decreased.

Static resistance (R_S) of a PN junction diode is a ratio of forward voltage (V_F) to the forward current (I_F).

$$R_S = V_F / I_F$$ Where, R_S = Static resistance of the component

Dynamic resistance (R_d) of a PN junction diode is a ratio of small change in forward voltage ($\blacktriangle V_F$) to small change in forward current ($\blacktriangle I_F$).

$$R_d = (\blacktriangle V_F) / (\blacktriangle I_F)$$ Where, R_d = Static resistance of the component

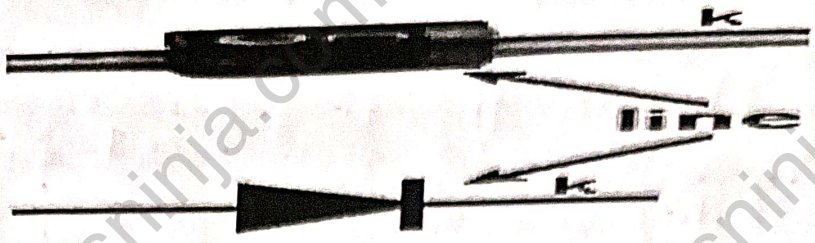


Figure 3.1: Diode and its symbol

VII Practical setup in Laboratory

(a) Sample

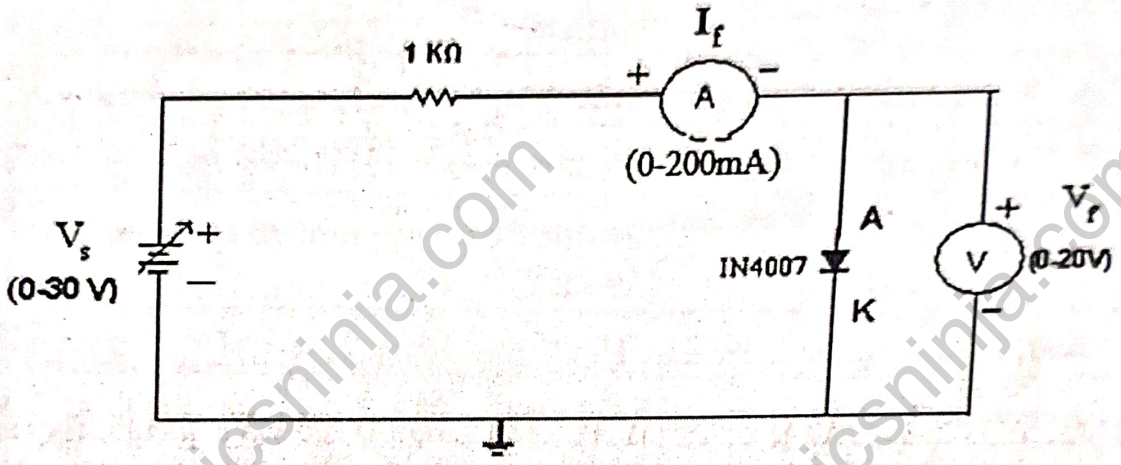
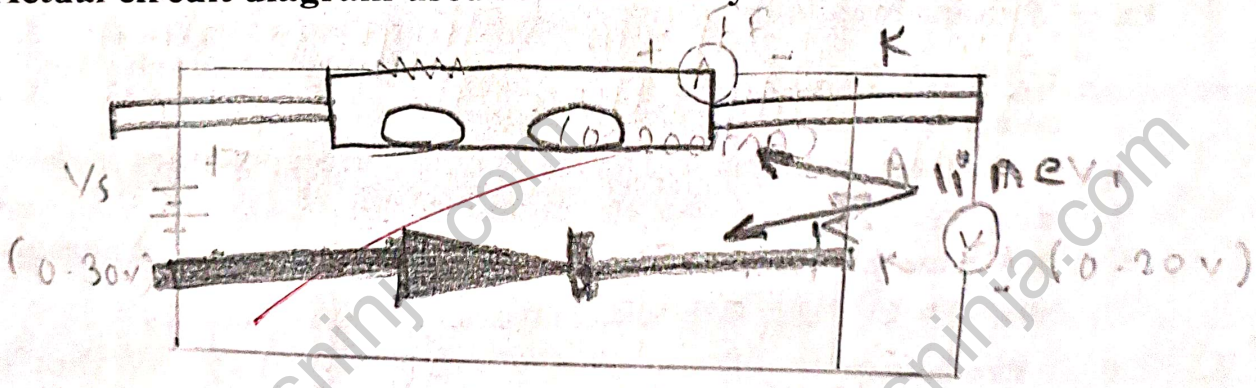
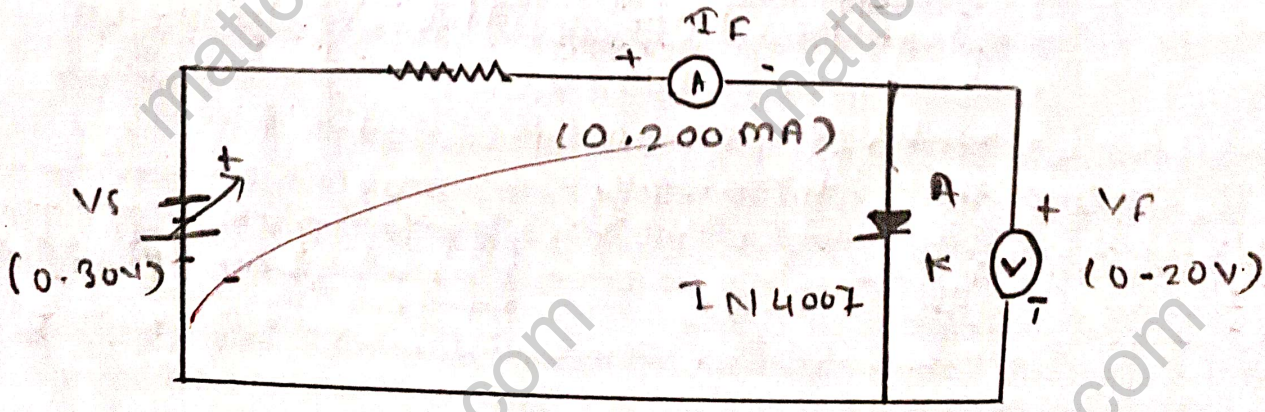


Figure 3.2: Circuit diagram of diode in forward

(b) Actual circuit diagram used in Laboratory



(c) Actual practical set up used in Laboratory



VIII Required Resources/apparatus/equipment with specifications

Sr. No	Instruments/Components	Specification	Quantity
1.	Multimeter	3 ½-digit display with AC and DC voltage measurement and Current measurement facility and Diode testing facility.	1
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1
3.	DC Voltmeter	0-20 V	1
4.	DC Ammeter	0 - 200 mA	1
5..	Diode	IN4007(or any another equivalent diode)	1
6.	Resistor	1KΩ(0.5watts/0.25watts)	1
7.	Bread board	5.5 CMX 17CM	1
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requiremer

IX Precautions to be followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. Connect voltmeter and ammeter with correct polarities as shown in the circui diagram.
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X Procedure

1. Connect the circuit as shown in figure 3.2
2. Switch ON the power supply.
3. Record the voltage V_F and current I_F in the observation table
4. Increase the input voltage in step of 0.1 V
5. Again, record the voltage V_F and current I_F in the observation table.
6. Repeat steps 4 to 5 till input voltage is reached to 1V.
7. Plot the graph for the forward bias characteristics of diode by taking V_F on X axis and I_F on Y- axis.
8. Calculate the static resistance at a particular point, on the characteristics.
9. Considering two points on the plotted graph, calculate dynamic resistance.

XI Observation Table

Table 1: Measurement of V_F and I_F

Sr. No.	V_F (volts)	I_F (mA)
1	0.0	0
2	0.1	0.000208
3	0.2	0.00014417
4	0.3	0.00082
5	0.4	0.036
6	0.5	0.086089
7	0.6	0.16
8	0.7	0.239
9	0.8	0.323
10	0.9	0.411

Calculations:

Calculate static resistance at particular point

$R_S = V_F / I_F$ where, R_S =Static resistance of the component

0.5/0.49 = 1.020 ohm

Calculate dynamic resistance

$R_d = \blacktriangle V_F / \blacktriangle I$ where, Rd =Dynamic resistance of the component

.20.60/6 = 3.43 ohm

XII Results

1. Static resistance of given diode= ..... 3.14 .....
2. Dynamic Resistance of given diode =..... 11 .....
3. Knee Voltage of given diode=..... 0.41 .....

XIII Interpretation of results

We observe the knee voltage of diode and ohmic resistance in this practical we intercept observation of knee voltage and static resistance of diode.

XIV Conclusions and Recommendation

In this practical we have performed charact. cs of diode and observe it.

XV Practical related Questions

1. List important specification of diode.
2. Find out the voltage across silicon diode at knee voltage.
3. Find out the voltage across germanium diode at knee voltage.
4. If in reverse biased condition input voltage across the diode in increase then what is the effect on electric field of diode?

[Space for answers]

① ——— ?

→ The value of the cut in voltage or the knee voltage of the silicon diode is fixed and is about 0.7 volts. Germinum diodes have a very less knee or cut-in voltage of about 0.3 volts only. Hence the answer is 0.7 volts.

② ——— ?

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XVI References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=Fwj_d3uO5g8
2. https://www.youtube.com/watch?v=qu9reCzzrco
3. https://www.youtube.com/watch?v=Nds6Qrd6k40

XVII Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Proper connection of electrical circuit	20%
2	Handling of instrument	10%
3	Taking proper readings	20%
4	Working in team.	10%
Product related (10 Marks)		**40%**
1	Calculate theoretical value of given component.	10%
2	Interpretation of Result & conclusion	05%
3	Practical related questions	15%
4	Completion and submission of experiment in time	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. .....
2. .....
3. .....
4. .....

Marks Obtained			Dated Signature of Teacher
Process Related(15)	Product Related(10)	Total (25)	
12	10	22	