Experiment 2

V-I Characteristics of Diode

OBJECTIVES:

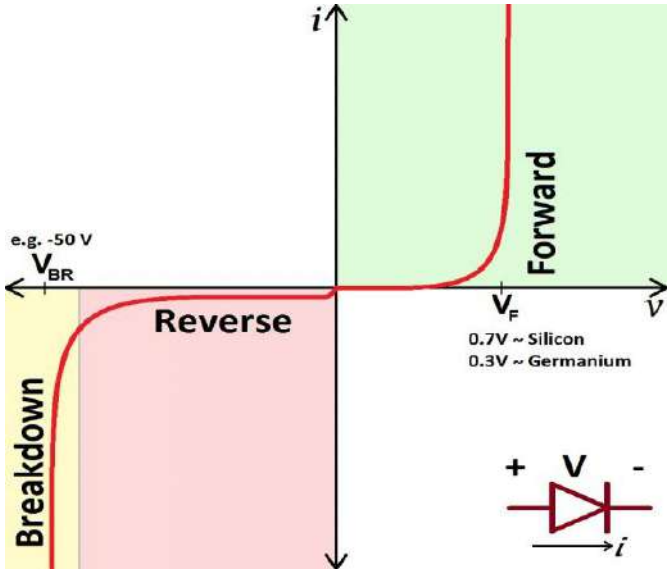
- To study and verify the functionality of Diode in forward bias and reverse bias and to plot Volt-Ampere Characteristics of simple Diode.
- To study and verify the functionality of a Transistor to plot Volt-Ampere Characteristics of aTransistor.

Operation:

The P-N junction diode is the most essential and the basic building block of the electronic device. The PN junction diode is a two terminal device, which is formed when one side of the PN junction diode is made with p-type and doped with the N-type material. The PN-junction is the root for semiconductor diodes. There are three possible biasing conditions and two operating regions for the typical PN-Junction Diode, they are: zero bias, forward bias and reverse bias. When no voltage is applied across the PN junction diode then the electrons will diffuse to P-side and holes will diffuse to N-side through the junction and they combine with each other. Therefore, the acceptor atom close to the P-type and donor atom near to the N-side are left unutilized. An electronic field is generated by these charge carriers. This opposes further diffusion of charge carriers. Thus, no movement of the region is known as depletion region or space charge. If we apply forward bias to the PN-junction diode that means negative terminal is connected to the P-type material and the positive terminal is connected to the N-typematerial across the diode which has the effect of decreasing the width of the PN junction diode. If we apply reverse bias to the PN-junction diode, that means positive terminal is connected to the P-type material and the negative terminal is connected to the N-type material across the diode which has the effect of increasing the width of the PN junction diode and no charge can flow across the junction.

Characteristics of a P-N Junction Diode

It generally shows the relation between bias voltage and current of a diode. The V-I characteristics of a diode can be forward or reverse. The graph showing the forward bias voltage and forward current is known as the forward characteristics, and that showing the reverse bias voltage and reverse current is known as the reverse characteristics.



The forward characteristics of a diode is non-linear. The forward current increases slowly in the beginning and shows a sudden rise at a certain value of forward voltage. This voltage is known as the threshold voltage or Knee voltage. This is because the resistance is very low in forward biased condition. The current in the reverse bias is due to the flow of minority carriers. The reverse current shows a sudden increase at a particular region. The corresponding voltage is termed as the reverse breakdown voltage.

Material Required:

- Variable resistors
- Voltmeter
- Ammeter
- Connecting Wires
- A p-n junction diode
- 1-15V battery

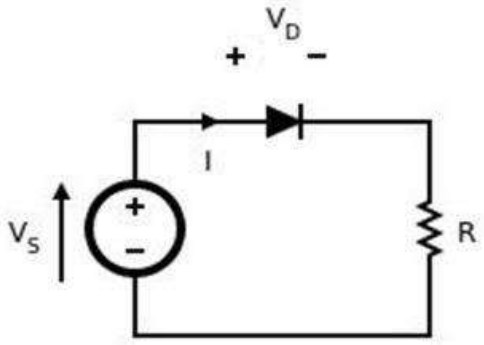


Fig.1 forward biased diode

Procedure

a) Forward Bias Condition:

1. Connect the circuit as shown in figure (1).

Initially vary Vs in steps. Once the current starts increasing vary Vs in steps of 1V up to 12V. Notedown the corresponding readings of V_d and I_d

Table 1: Forward Bias Condition

Vs(volts)	**Forward Voltage across the diode V_d (volts)**	**Forward Current through the diode I_d (mA)**

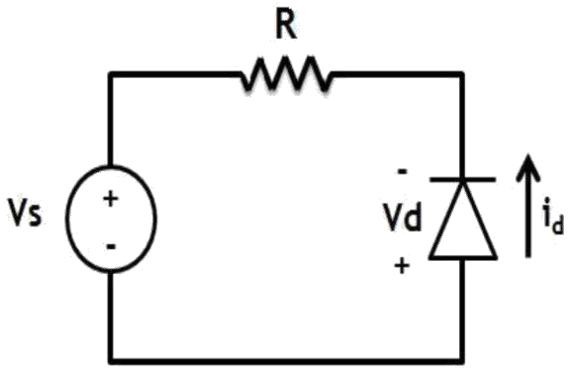


Fig.2 Reverse Bias Diode

b) Reverse Bias Condition:

1. Connect the circuit as shown in figure (2).
2. Vary Vs gradually in steps of 1V up to 12V and note down the corresponding readings of V_d and I_d.
3. Tabulate different reverse currents obtained for different reverse voltages.

Table 2: Reverse Bias Condition

Vs(volts)	**Reverse Voltage across the diode V_d (volts)**	**Reverse Current through the diode I_d (mA)**

c) With help of measured values in table 1 and 2 draw V-I characteristics of diode

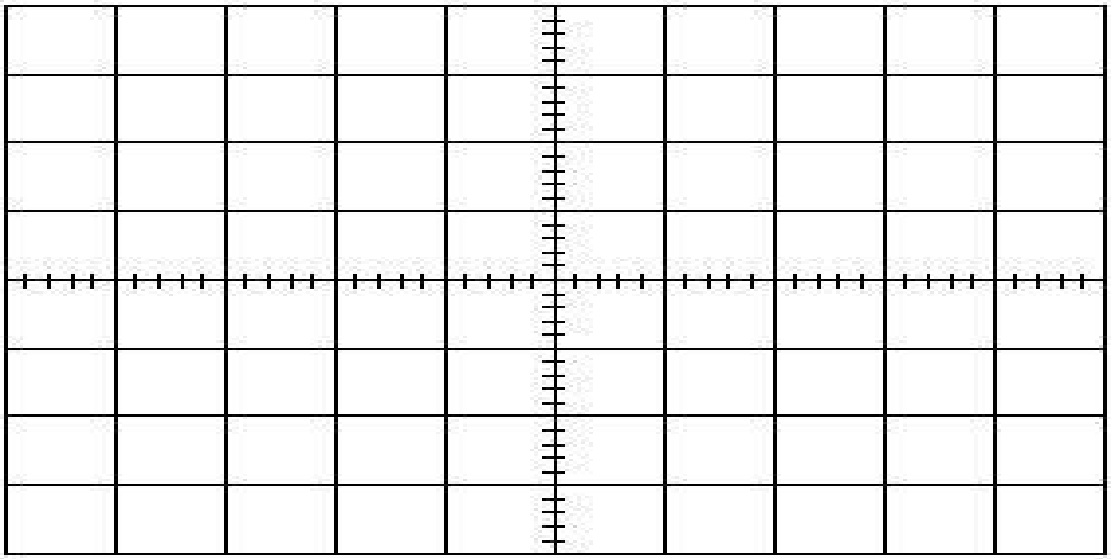


Fig.3 V-I Characteristics of Diode

Lab Exercise and Summary

Summary should cover Introduction, Procedure, Data Analysis and Evaluation.

Student's Signature:_____ **Date:**_____

LABORATORY SKILLS ASSESSMENT (Psychomotor)

Total

Criteria (Max Marks)	Level 1 0% ≤ S < 50%	Level 2 50% ≤ S< 70%	Level 3 70% ≤ S< 90%	Level 4 90%≤ S ≤100%	Score (S)
Procedural Awareness (20)	Selects inappropriate skills and/or strategies required by the task.	Selects and applies appropriate skills and/or strategies required by the task with major errors.	Selects and applies the appropriate strategies and/or skills specific to the task without significant errors.	Selects and applies appropriate strategies and/or skills specific to the task without any error.	
Practical Implementation (30)	Makes major critical errors in applying procedural knowledge related to V-I Characteristics of Diode	Makes numerous critical errors in applying procedural knowledge related to V-I Characteristics of Diode	Makes some non-critical errors in applying procedural knowledge related to V-I Characteristics of Diode	Applies the procedural knowledge in optimized ways related to V-I Characteristics of Diode	
Participation to Achieve Group Goals (10)	Shows little commitment to achieve group goals and fails to perform assigned roles.	Demonstrates commitment to achieve group goals, but has difficulty in performing assigned roles.	Demonstrates commitment to achieve group goals and carries out assigned roles effectively.	Actively helps to identify, achieve group goals and works effectively to meet them in all roles assumed.	
Interpersonal Skills in Group Work (10)	Rarely interacts positively within a group, even with prompting.	Interacts with other group members if prompted.	Interacts with all group members spontaneously.	Interacts positively with all group members and encourages such interaction in others.	
Use of Tool/Equipment (20)	Uses tools, equipment and materials with limited competence.	Uses tools, equipment and materials with some competence.	Uses tools, equipment and materials with considerable competence.	Uses tools, equipment and materials with a high degree of competence.	
Safety (10)	Requires constant reminders to follow safety procedures.	Requires some reminders to follow safety procedures.	Follows safety procedures with only minimal reminders.	Routinely follows safety procedures.	
				Marks Obtained	

Marks: 100

Instructor Name: _____ **Sign: _____**

LABORATORY SKILLS ASSESSMENT (Affective)

Total Marks: 40

Criteria (Max. Marks)	Level 1 0% ≤ S < 50%	Level 2 50% ≤ S < 70%	Level 3 70% ≤ S < 90%	Level 4 90% ≤ S ≤ 100%	Score
Introduction (5)	Very little background information provided or information is incorrect	Introduction is brief with some minor mistakes	Introduction is nearly complete, missing some minor points	Introduction complete and well-written; provides all necessary background principles for the experiment	
Procedure (5)	Many stages of the procedure are not entered on the lab report.	Many stages of the procedure are entered on the lab report.	The procedure could be more efficiently designed but most stages of the procedure are entered on the lab report.	The procedure is well designed and all stages of the procedure are entered on the lab report.	
Data Record (10)	Data is brief and missing significant pieces of information.	Data provides some significant information and has few critical mistakes.	Data is almost complete but has some minor mistakes.	Data is complete and relevant. Tables with units are provided. Graphs are labeled. All questions are answered correctly.	
Data Analysis (10)	Data is presented in very unclear manner.	Data is presented in ways that are not clear enough.	Data is presented in ways that can be understood and interpreted.	Data is presented in ways that best facilitate understanding and interpretation.	
Report Quality (10)	Report contains many errors.	Report is somewhat organized with some spelling or grammatical errors.	Report is well organized and cohesive but contains some grammatical errors.	Report is well organized and cohesive and contains no grammatical errors. Presentation seems polished.	
				Marks Obtained	

LABORATORY SKILLS ASSESSMENT (Cognitive)

Total Marks: 10

(If any) **Marks Obtained**	

Instructor's Signature: _____ **Date: _____**