Jawaharlal Nehru Engineering College

Laboratory Manual

BASIC ELECTRONICS ENGINEERING

For

First Year Students

Lab manual made by

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Jawaharlal Nehru Engineering College

Technical Document

This technical document is a series of Laboratory manuals of Electronics and Telecommunication Department and is a certified document of Jawaharlal Nehru engineering College. The care has been taken to make the document error-free. But still if any error is found, kindly bring it to the notice of subject teacher and HOD.

Recommended by,

HOD

Approved by,

Principal

FOREWORD

It is my great pleasure to present this laboratory manual for first year engineering students for the subject of Basi Electronics Engineering to understand and visualize the basic concepts of Electronics Engineering.

As a student, many of you may be wondering with some of the questions in your mind regarding the subject and exactly what has been tried is to answer through this manual.

Faculty members are also advised that covering these aspects in initial stage itself, will greatly relieve them in future as much of the load will be taken care by the enthusiastic energies of the students once they are conceptually clear.

Good Luck for your Enjoyable Laboratory Sessions.

H.O.D
ECT Dept

LABORATORY MANUAL CONTENTS

This manual is intended for the First-Year students in the subject of Basic Electronics Engineering. This manual typically contains practical/ Lab Sessions related to Basic Electronics Engineering covering various aspects related to the subject for enhanced understanding.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books.

Good Luck for your enjoyable Laboratory Sessions.

SUBJECT INDEX:

Lab Exercises

1. To study basic electronic components
2. To study electronic instruments
3. To study basic logic gates
4. To plot V-I characteristics of a diode.
5. Study of Home Appliances

Exercise No. 1:(2 Hour)

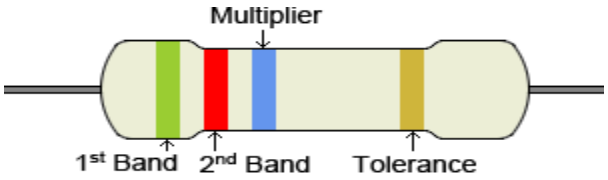
Aim: - To study basic electronic components.

Theory:

Depending upon the power delivering or absorbing ability, the circuit components can be classified in two types – Passive components and Active components.

The passive components such as resistor, inductor, capacitor, etc. do not require any source of electricity to function, they use some other property to control the power in the circuit, whereas the active components like diodes and transistors use electrical energy to function, i.e., to control the power in the circuit.

1. Resistor



Color	1st, 2nd Band Significant Figures	Multiplier	Tolerance
Black	0	× 1	
Brown	1	× 10	±1% (F)
Red	2	× 100	±2% (G)
Orange	3	× 1K	±0.05% (W)
Yellow	4	× 10K	±0.02% (P)
Green	5	× 100K	±0.5% (D)
Blue	6	× 1M	±0.25% (C)
Violet	7	× 10M	±0.1% (B)
Grey	8	× 100M	±0.01% (L)
White	9	× 1G	
Gold		× 0.1	±5% (J)
Silver		× 0.01	±10% (K)

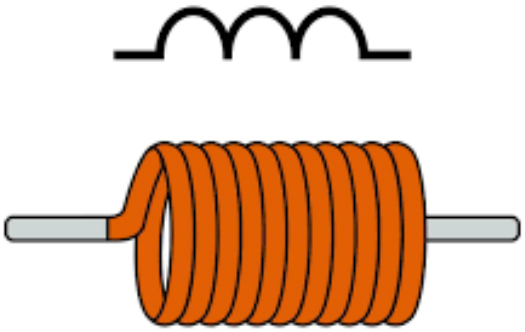
A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. This relationship is represented by Ohm's law. A device used in electrical circuits to maintain a constant relation between current flow and voltage. They are typically marked with an “R” on a circuit board. They are of two types fixed and variable.

2. Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. Capacitors are also very commonly used. A lot have their values printed on them, some are marked with 3-digit codes, and a few are color coded. They are typically marked with an “C” on a circuit board.

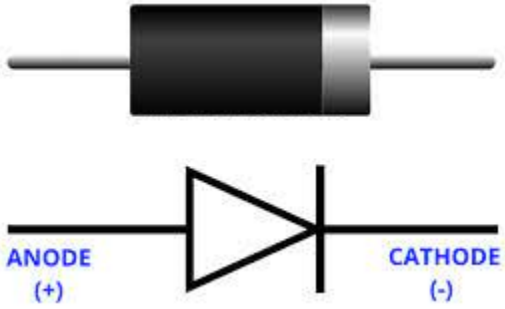
3. Inductor

An inductor, also called a coil or reactor, is a passive two-terminal electrical component which resists changes in electric current passing through it. They are typically marked with an “L” on a circuit board.



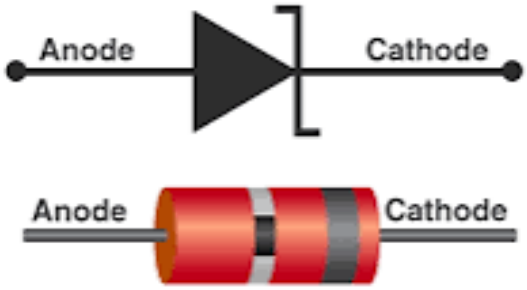
4. Semiconductor diode

A diode is a two-terminal electronic component that has a low resistance to the flow of current in one direction thus allowing the passage of current in one direction whereas there will be a high resistance in the other, thus restricting the flow of current in that direction. Semiconductor diodes are two-terminal devices that consist of a p-n junction and metallic contacts at their two ends.



5. Zener Diode

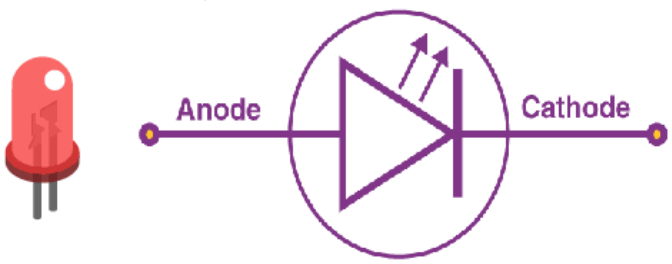
A Zener diode is a highly doped semiconductor device specifically designed to function in the reverse direction. It is engineered with a wide range of Zener voltages (Vz), and certain types are even adjustable to achieve variable voltage regulation.



6. Light Emitting Diode (LED)

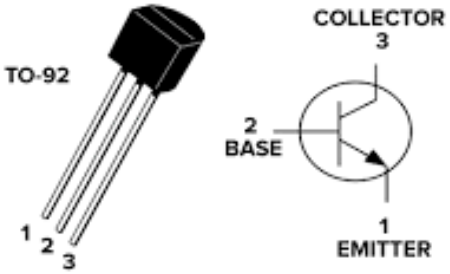
A light-emitting diode (LED) is a semiconductor device that emits light when

an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.



7. Transistor

A transistor is a semiconductor device used to amplify or switch electrical signals and power. It is one of the basic building blocks of modern electronics. It is composed of semiconductor material, usually with three terminals for connection to an electronic circuit i.e. emitter, base and collector.



<u>Conclusion</u>: - Hence studied basic components and verified value of resistor.

Exercise No. 2:(2 Hour)

Aim: - To study electronic instruments.

Apparatus: - DC Power Supply, DMM, Function Generator, CRO, Probes, etc.

Theory:

Power Supply

Power Supply is designed as a Constant Current (CC) and Constant Voltage (CV) source for use in laboratories, industries and field testing. With compact size, light weight and low power loss it, provides DC output voltages for Analog and Digital testing. The DC output can be adjustable from 0 - 30 V with Coarse and Fine controls. Current limit is adjustable from 0 - 1A. Over loading is indicated by LED. A 3-digit LED display for voltage & current is used to read the values. These two parameters can be switched to display either voltage or current.

Digital Multimeter

A digital multimeter (DMM) is a test tool used to measure two or more electrical values—principally voltage (volts), current (amps) and resistance (ohms).

Types of Multimeters

There are two common types of Multimeters, Analog and Digital. Digital Multimeters (DMMs) are the most common.

The Digital Multimeter (DMMs) feature a digital or liquid crystal display (LCD). Measurement readings are displayed as numerical values on the LCD Display.

Setting the Function, the dial of the DMM allows you to choose the function you're interested in measuring. Whether you intend to measure one of the three elements of Ohm's Law, or a more advanced function like frequency or capacitance, you must first set the dial to the appropriate function. Setting the Range, the dial also plays another essential role in measuring electricity – that of determining the range of measurement. The range you select on the dial determines the placement of the decimal point as it appears on the LCD. In turn, the position of the decimal point determines how refined, or precise, your reading is. This is called resolution.

Function Generator

Another major equipment, which is used commonly in electronic circuit applications, is a Function Generator (FG). As the name indicates, a Function Generator generates different voltage signals, such as Sine, Pulse, Triangle.

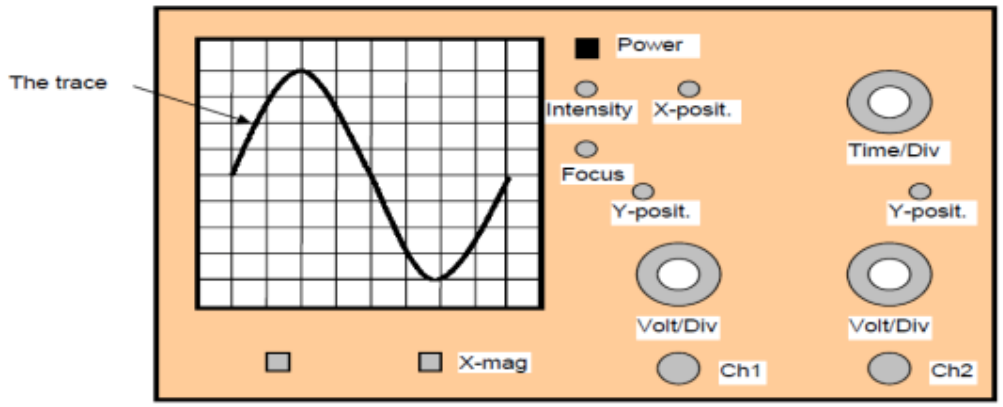
In a FG by the touch of a button one can switch over from one signal to another one. This is possible because of the fact that one can obtain different signals from a starting signal using Wave shaping circuits. Most FGs generate a Triangular signal and derive Sine and Pulse signals from it.

Cathode Ray Oscilloscope (CRO)

The Oscilloscope is probably the single most versatile and useful Test and Measurement instrument invented for electronic measurement applications. It is a complex instrument capable of measuring or displaying a variety of signals. This is the basic equipment used in almost all electronic circuit design and testing applications.

Front Panel Controls:

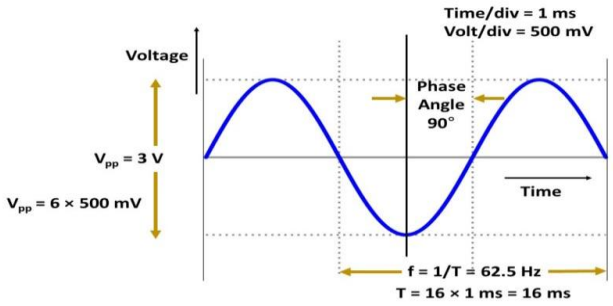
1. **Intensity control:** is used to adjust the brightness of the waveform. As the sweep speed is increased, there is a need to increase the intensity level.
2. **Focus control:** is used to adjust the sharpness of the waveform.
3. **Trace control:** is used to rotate the trace on the CRO screen.
4. **Calibration point:** is used to calibrate the CRO. It gives a steady square wave at a particular set frequency and voltage. It allows the accurate scaling of the trace. The standard calibration signal is 0V-2V at 1KHz.
5. **Volts/div.:** For selecting desired voltage sensitivity of the vertical amplifier to obtain the proper wave form on the screen.
6. **Volts/div. Variable:** Provides continuously variable voltage sensitivity. Calibrated position is fully clockwise.
7. **Position:** Controls horizontal position of trace on screen.
8. **Vertical Position knob:** To move the trace up or down the on the screen.
9. **Horizontal Position Knob:** With this knob we can adjust the position of lighted spot or wave, horizontally i.e., along with x-axis.



Measurement of amplitude and frequency of a waveform on CRO

To measure the alternating voltage of sinusoidal waveform, The A.C. signal, from the signal generator, is applied across the y – plates. The volt/div and time/div knobs are adjusted such that a steady picture of the waveform is obtained on the screen. The vertical height (l) i.e., peak-to-peak height is measured. When this peak-to-peak height (l) is multiplied by volt/div, we get the peak-to-peak amplitude.

To measure the frequency, The horizontal length(l) between two successive peaks is noted. When this horizontal length (l) is multiplied by the time base i.e., sec/div, we get the time-period(T). The reciprocal of the time-period(1/T) gives the frequency(f).



Conclusion: Hence studied the front panel control of Electronics instruments.

Exercise No. 3:(2 Hour)

Aim: - To study basic logic gates.

Apparatus: - Digital trainer kit, Bread board, wires, IC-7408(AND), 7432(OR), 7404 (NOT), etc.

Theory:

A logic gate is a device that acts as a building block for digital circuits. They perform basic logical functions that are fundamental to digital circuits.

There are seven logic gates:

1. Basic logic gates: - AND, OR, NOT
2. Universal gates: - NAND, NOR
3. Special purpose gates: - XOR, and XNOR.

1. AND Gate:

Logical AND operation is defined as "the output is 1 if all the inputs are 1". Circuit of logical AND is shown below. It has N inputs (N >= 2) and one output. Digital signals are applied at the input terminal marked A,B,C….,N ,the other terminal being grounded (not shown in diagram). The output is obtained at the terminal marked Y, and it is also a digital signal.

Mathematically, AND operation is written as

Y=A AND B
Y=A .B
Y=AB

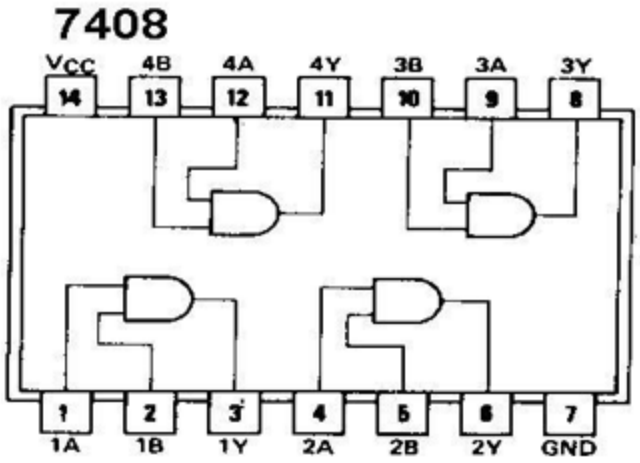


Fig1. Pin Diagram Of AND Gate IC

Symbol:

Truth Table:

Inputs		Output
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

2. OR Gate:

Logical OR operation is defined as "the output is 1 if at least one of the inputs is 1". Circuit of logical OR is shown below. It has N inputs (N>=2) and one output. Digital signals are applied at the input terminal marked A,B,C….,N, the other terminal being grounded(not shown in diagram).The output is obtained at the terminal marked Y, and it is also a digital signal.

Mathematically, OR operation is written as

Y=A OR B
Y=A +B

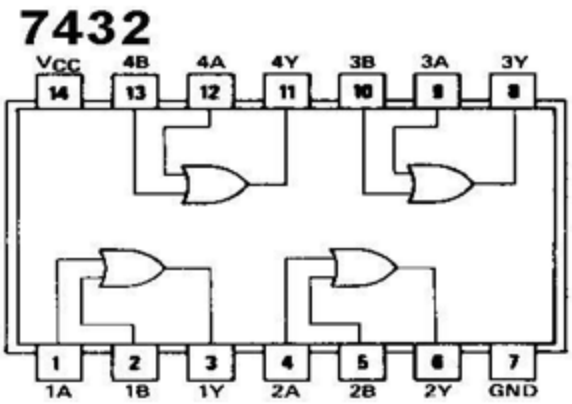


Fig 2.Pin Diagram of OR Gate IC

Symbol

Truth Table for OR operation

Inputs		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

3. NOT Gate:

Logical NOT operation is also called as Inverter. It has One input (A) and one output (Y).

Its logic Equation is written as

Y = NOT A
Y= A'
Y=Ā

It is read as "Y equals not A" or "Y equals complement of A".

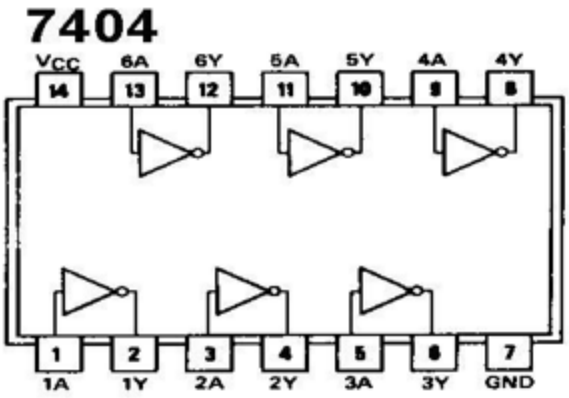
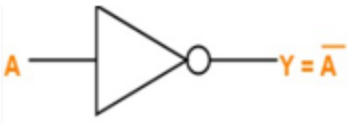


Fig 3.LOGIC DIAGRAM OF NOT GATE

Symbol



Truth Table for NOT operation

INPUT	OUTPUT
A	Y
0	1
1	0

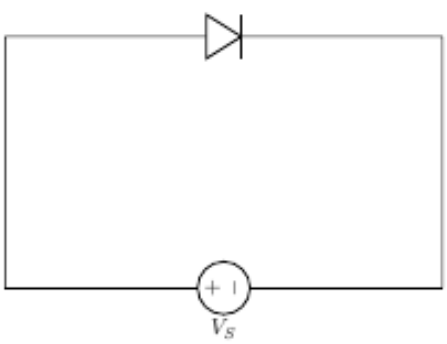
Conclusion: - Hence verified the logical AND, OR, NOT Operation.

Exercise No. 4 :(2 Hour)

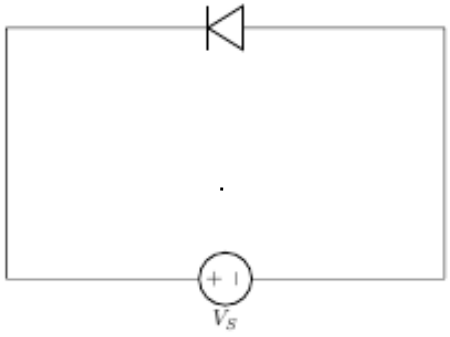
Aim: - To plot V-I characteristics of a diode.

Apparatus: - Virtual Lab designed by IIT.

Circuit Diagram: -



Forward Biased

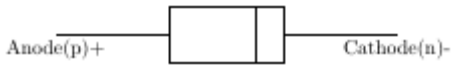


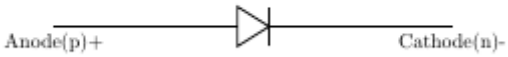
Reverse Biased

Theory: -

Structure of P-N junction diode

The diode is a device formed from a junction of n-type and p-type semiconductor 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.





Function of a P-N junction diode in Forward Bias

The positive terminal of battery is connected to the P side(anode) and the negative terminal of battery is connected to the N side(cathode) of a diode.

Function of a P-N junction diode in Reverse Bias

The positive terminal of battery is connected to the N side(cathode) and the negative terminal of battery is connected to the P side(anode) of a diode. Therefore, very little current will flow until the diode breaks down.

Forward and reverse biased characteristics of a Silicon diode

In forward biasing, the positive terminal of battery is connected to the P side and the negative terminal of battery is connected to the N side of the diode. Diode will conduct in forward biasing because the forward biasing will decrease the depletion region width and overcome the barrier potential. In order to conduct, the forward biasing voltage should be greater than the barrier potential. During forward biasing the diode acts like a closed switch with a potential drop of nearly 0.6 V across it for a silicon diode.

The forward and reverse bias characteristics of a silicon diode. From the graph, you may notice that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage. In reverse biasing, the positive terminal of battery is connected to the N side and the negative terminal of battery is connected to the P side of a diode. In reverse biasing, the diode does not conduct electricity, since reverse biasing leads to an increase in the

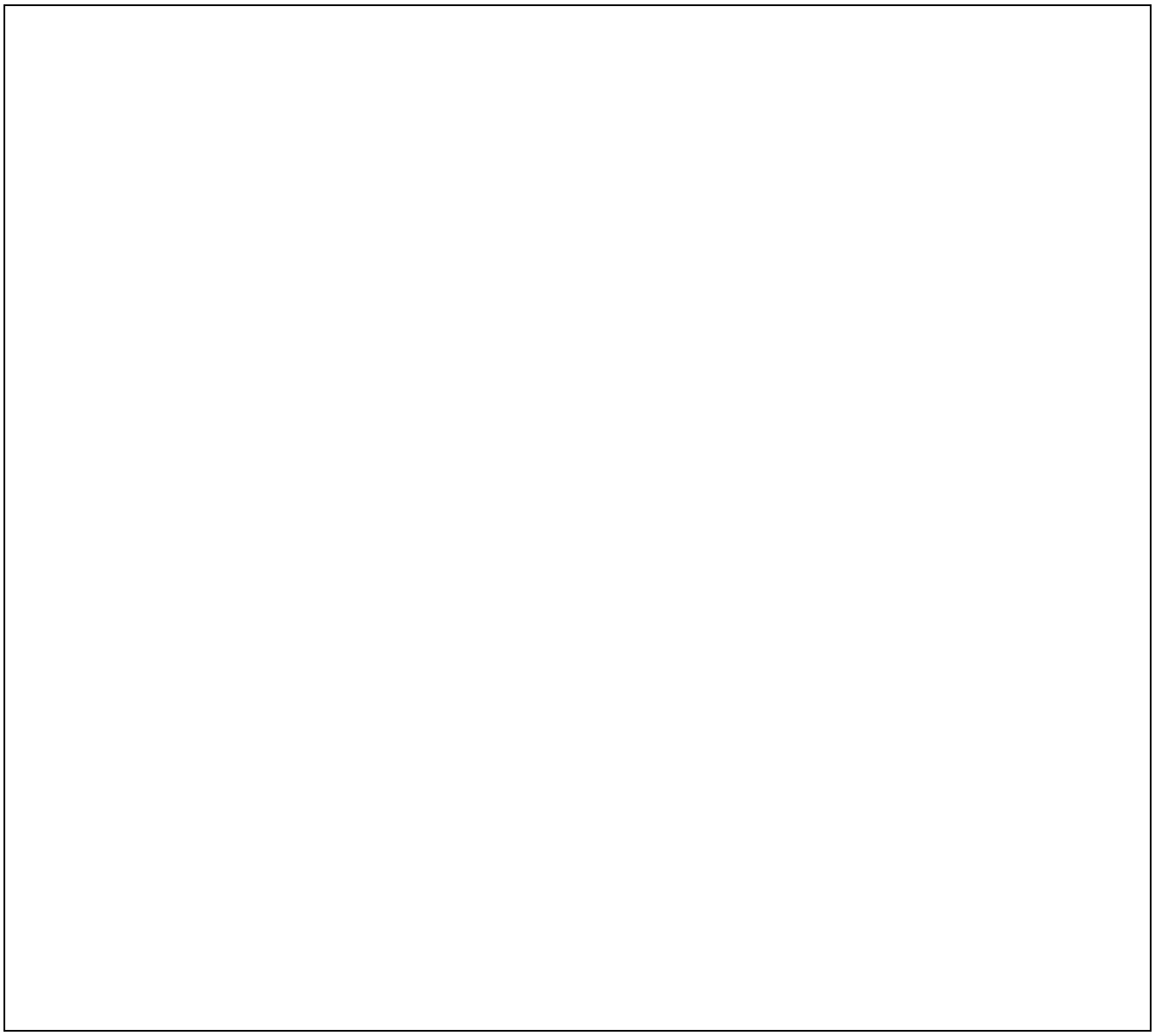
depletion region width; hence current carrier charges find it more difficult to overcome the barrier potential. The diode will act like an open switch and there is no current flow.

Procedure:

1. Set DC voltage to 0.2 V.
2. Select the diode.
3. Set the resistor.
4. Voltmeter is placed parallel to Silicon diode and ammeter series with resistor.
5. The positive side of battery to the P side(anode) and the negative of battery to the N side(cathode) of the diode.
6. Now vary the voltage upto 5V and note the Voltmeter and Ammeter reading for particular DC voltage.
7. Take the readings and note Voltmeter reading across Silicon diode and Ammeter reading.
8. Plot the V-I graph and observe the change.
9. Calculate the dynamic resistance of the diode. $rd=\Delta V/\Delta I$
10. Therefore, from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

Result: -

Attach a screen shot of your output in following box.



Conclusion: Therefore, from the graph we see that the diode starts conducting when the forward bias voltage exceeds around 0.6 volts (for Si diode). This voltage is called cut-in voltage.

Reverse breakdown occurs at around 30 V, i.e VBR = 30 V, after which current increases rapidly. This voltage is called as Reverse breakdown voltage.

Exercise No. 5 :(2 Hour)

Case Study of ------- (Name of Appliance)

Kindly Include:

1. Title Page
2. Survey Form
3. PPTs:
   - Title
   - Contents:
     - Features
     - Front panel diagram with proper label and functions of each control
     - Block diagram with proper labels
     - Explanation of each block
     - Construction
     - Working Principle
     - Advantages Disadvantages