VINAYAKA MISSION'S RESEARCH FOUNDATION, SALEM

(Deemed to be University)

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, CHENNAI

Department of Electronics & Communication Engineering

Academic Year 2021 – 2022, Odd Semester

R2021

ENGINEERING SKILLS PRACTICE LAB

(B. BASIC ELECTRONICS ENGINEERING)
Lab Manual

Course: B.E	Programme: ECE
Year: I, Semester: I	Batch: 2021 – 2025

Name : ______________________________
Year : ______________________________
Roll No : ______________________________
Register No : ______________________________

HOD/ECE

B. BASIC ELECTRONICS ENGINEERING:

1. Practicing of Soldering and De-soldering.
2. Characteristics of PN junction Diode and find the forward and reverse resistance
3. Construct and Study simple clipper and clamper circuits
4. Characteristics of Zener diode and determine the break down voltage and diode resistance
5. Construct and Study simple voltage regulator using Zener diode
6. Verification of Logic Gates.
7. Find the characteristics of AND ,NOR,NOT gate

LIST OF EXPERIMENTS

Sl. NO.	**EXPERIMENT NAME**	**PAGE NO.**	**DATE OF SUB.**	**STAFF SIGN.**	**REMARK**
1	Practicing of Soldering and De-soldering.				
2	2. Characteristics of PN junction Diode and find the forward and reverse resistance				
3	3. Construct and Study simple clipper and clamper circuits				
4	4. Characteristics of Zener diode and determine the break down voltage and diode resistance				
5	5.Construct and Study simple voltage regulator using Zener diode				
6	Verification of Logic Gates.				
7	Find the characteristics of AND ,NOR,NOT gate				

IDENTIFYING ELECTRONICS COMPONENTS

Aim: **Date :**

To study various electronic Components

RESISTORS:

a. Fixed Resistors

These resistors are called as fixed resistors. Because the resistance value is fixed and it cannot be varied.

b. Variable Resistors

These resistors are called as variable resistors because the resistance value is varied according to the requirements.

A **resistor** is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law:

$$V = IR$$

Resistors are elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

RESISTOR COLOUR CODE:

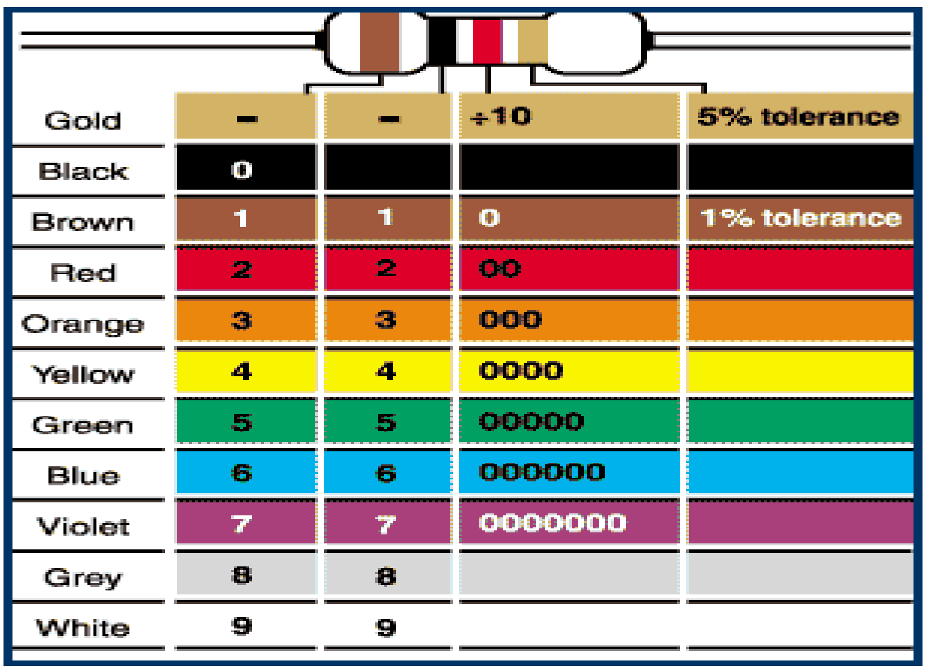
First find the tolerance band, which is typically gold (5%) and sometimes silver (10%), and hold the resistor such that this band is at your right-hand side. Starting from the other end, identify the first band at your left-hand side, write down the number associated with that color. For example, in this case of blue, we write down ‘6’. Then identify the color band next to it, for example if the second band is red, we write down a '2' next to the ‘6’. The first two bands are called digit band. Now read the third or multiplier band and write down that number of zeros, for example, if a green band, we multiply the quantity indicated by the digit bands with 10^5.

The resistance of this resistor, color coded by ‘blue-red-green-gold” is 62*10^5\onm = 6.2Meg ohm (1M ohm=10^6 ohm)

TOLERANCE BAND:

A perfect linear resistor has a constant resistance independent of current, voltage, temperature and other factors. In reality no resistor is prefect and even two resistors with the same marked value may have several percent differences if measured. Therefore, in addition to their value, resistors are marked with an indication of inaccuracy, called tolerance, measured in percent. The most used resistors have a tolerance of 5%, but if needed resistors down to 1% are available. For example, if the nominal value is 100 Ohm, the measured value could be between 100*(1-5%)—100*(1+5%) Ohm, i.e. 95-100 Ohm, given the tolerance being 5%.

Resistor color coding



Gold	–	–	÷10	5% tolerance
Black	0			
Brown	1	1	0	1% tolerance
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	0000000	
Grey	8	8		
White	9	9		

MEASUREMENT OF RESISTANCE:

- Switch on multi-meter
- Switch to Ohmmeter
- Enable "Auto Range" in order to get the maximum number of significant digits during measurement.
- Hold the resistor in your left hand and connect one end of a banana-to-mini-grabber cable to the instrument and the other end to the resistor.
- Record the resistance value and the unit from the LCD screen

<u>CAPACITORS:</u>

a. Fixed Capacitors

These capacitors are called as fixed capacitors. Because the capacitance value is fixed and it cannot be varied.

b. Variable Capacitors

These capacitors are called as variable capacitors because the capacitance value is varied according to the requirements.

CALCULATE PERCENTAGE ERROR:

For a given resistor, we measure the difference between its nominal resistance and measured resistance in the percentage, which is called percentage error, given by

$$PE = \frac{|NV - MV|}{NV} * 100\%,$$

where PE represents for percentage error, NV for nominated value and MV for measured value.

A capacitor or condenser is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

WORKING PRINCIPLE:

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive substance is called the dielectric medium, although this may also mean a vacuum or a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from an external electric field. The conductors thus contain equal and opposite charges on their facing surfaces, and the dielectric contains an electric field. The capacitor is a reasonably general model for electric fields within electric circuits.

An ideal capacitor is wholly characterized by a constant capacitance 'C', defined as the ratio of charge ±'Q' on each conductor to the voltage 'V' between them: **C=Q/V**

Sometimes charge buildup affects the mechanics of the capacitor, causing the capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$C=dq/dv$$

In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device. Capacitors are widely used in electronic circuits to block the flow of direct current while allowing alternating current to pass, to filter out interference, to smooth the output of power supplies, and for many other purposes. They are used in resonant circuits in radio frequency equipment to select particular frequencies from a signal with many frequencies.

INDUCTORS:

a. Fixed Inductors

The inductance value is fixed and cannot be varied. Air core inductors are used, very low value of inductance is required.

b. Variable Inductor

In certain applications such as tuned circuits, it is required to vary to the maximum value. Ferrite core variable inductors are generally used for this purpose.

c. Magnetic coil Inductors

They have coil containing a number of terms of copper wire material pass through the former in such a way that it forms the closed magnetic path for the magnetic flux.

An inductor is a conducting coil, wrapped around a core, that creates inductance when an alternating current flows through it. Inductors are used to impede the flow of current in a circuit. The conductor is usually thin magnet wire, and the core is usually air or steel.

WORKING PRINCIPLE:

When the alternating current flows through an inductor, it creates an electromagnetic field. The strength of this field depends on number of coils, the coil diameter and the permeability of the core material. Steel has a much higher permeability than air and produces a stronger field. As the current changes direction, the field also experiences a change and causes an induced current to flow in the opposite direction and impede the current flow.

ACTIVE DEVICES:

There are many types of transistor, the main ones being the bipolar junction transistor (BJT) and the field-effect transistor (FET).

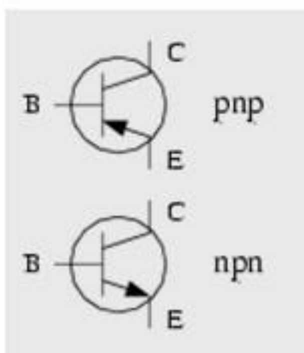
BIPOLAR JUNCTION TRANSISTOR:

The bipolar junction transistors has three terminals: collector, base, and emitter. They are used as switches and signal amplifiers, and are commonly packaged in small plastic or metal cases with the three terminals on one end.

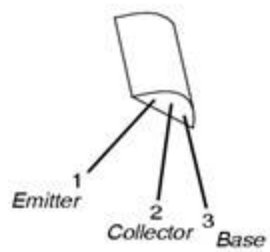
Bipolar junction transistors have three leads connected internally to two semiconductor junctions. As the voltage rises in the base terminal, the current flowing between the emitter and collector terminals increases. At this stage, the transistor is behaving as an amplifier for the base signal.

As the base voltage is increased, a point is reached where no more current will flow. This is called the saturation state, and the transistor is now behaving like a closed switch.

SYMBOL OF BJT:



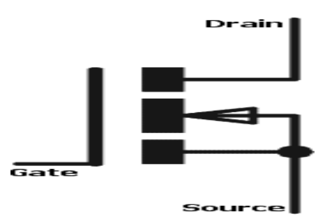
PIN ASSIGNMENT OF BJT:



FIELD EFFECT TRANSISTOR:

The field-effect transistor has four leads: source, gate, drain, and body. The most common FET is the MOSFET, or metal-oxide-semiconductor field-effect transistor. They are commonly used inside integrated circuits as switches.

SYMBOL OF FET:



USES FOR TRANSISTORS:

Transistors are found in practically every electrical device more complicated than a light bulb. There are hundreds inside every radio and television, and computer chips have millions of transistors etched onto a tiny piece of silicon.

DIODE:

1.Rectifier Diode

The process of converting AC in to DC is called rectification and it is achieved using diode. Rectifier diode rectify the AC waveform and convert it into a unidirectional or pulsating DC waveform.

2. Zener Diode

These diodes are known as far high breakdown voltage. The breakdown voltage of diode can be varied by changing the doping level. This diode has maximum power dissipation.

TRANSISTORS

1. PNP Transistor

The forward bias supplied to the emitter base junction of a PNP transistor causes a lot of holes from the emitter region to cross over to the base region

2. NPN Transistor

It is uni-junction three terminal device. It consists of the P type base at the centre of which N -Type material is diffused. The terminal attached to the N type material is called emitter.

3. Field Effect Transsistor(FET)

3.1 N-Channel JFET

Two Ohmic contacts are taken from the emitter and either ends of n-bar terminals connected to these points are source and drain. Electrons are current carriers.

3.2 P-Channel JFET

This is called positive channel JFET because in this case holes will be the current carriers instead of electrons.

4. Metal Oxide Semiconductor Field Effect Transistor

It is also known as insulator gate field effect transistor.

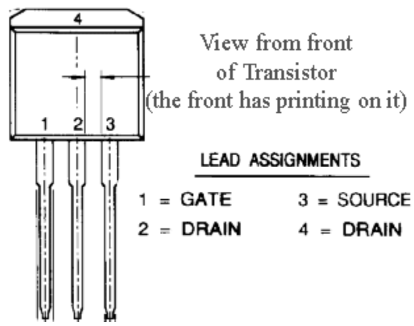
Depletion MOSFET

When the gate to source voltage Vgs=0 maximum drain current flow, when Vgs= -ve the new diffused channel will become less conductive has the induced positive charge in the diffused channel increased.

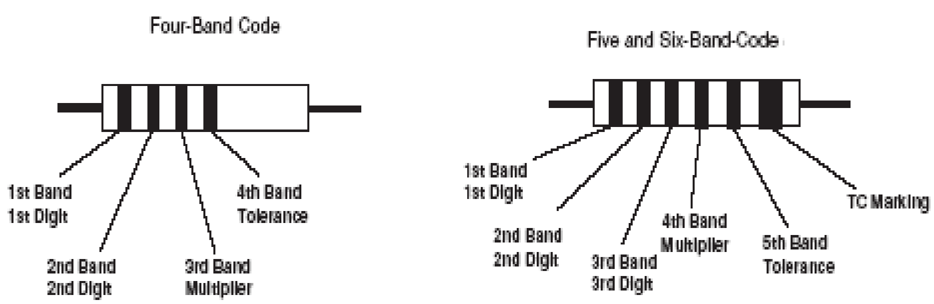
Enhancement MOSFET

When a –ive voltage is applied to gate terminal, in includes positive charge in N type substrate which refers to an inversion layer.

PIN ASSIGNMENT OF FET:



RESISTANCE COLOUR CODE:



EXERCISE:

Read the color codes of 3 resistors and identify their resistances.

Resistor	**Color codes**	**Nominated value**	**Measured Value**	**Percentage Error**
1				
2				
3				

Result:

PRACTICING OF SOLDERING AND DESOLDERING

Ex.No: 1

Aim: Date:

To practice soldering and de-soldering for the given electronics circuits by assembling and disasembling.

Apparatus Required:

S.No	Item	Range	Quantity
1	PCB Board for given circuit		1
2	Soldering iron	60/40 grade	1
3	Solder		1
4	Electrician's knife		1
5	Nose plier		1
6	Flux		1
7	Resistor	1K	2
8	Capacitor	0.1µf	2

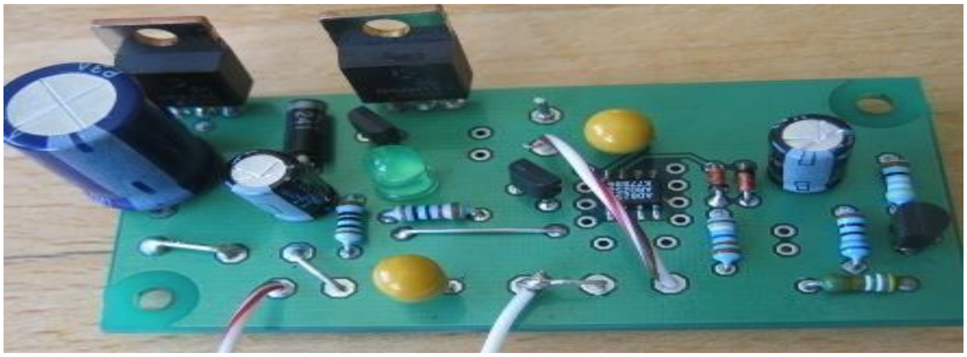
Procedure

Soldering

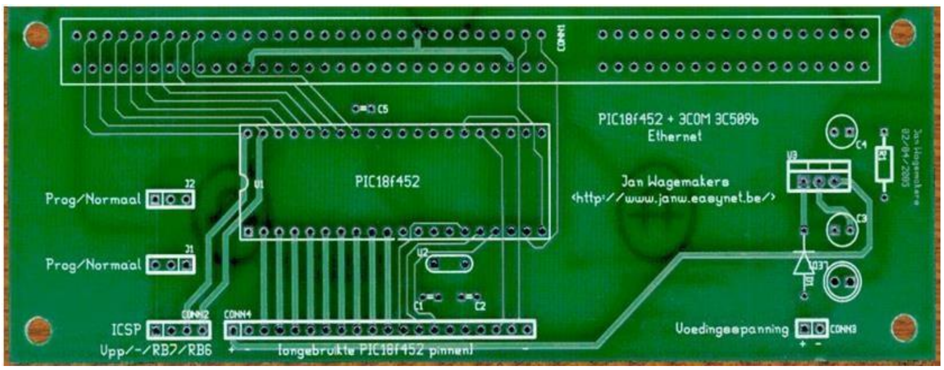
1. Study the electronics circuits
2. Clean the soldering side of the PCB Board using IPA(Iso Profile Alcohol)
3. Clean the soldering iron tips and ensure that it is placed correctly as the soldering stand before heating
4. Using nose plier bend the lead to 90deg for the requirement of the length
5. Insert the components properly on the PCB
6. Apply the flux on the component leads this process is avoiding oxidiation and present short circuit.
7. Take the soldering iron from the stand and apply the solder to the tip of the soldering iron
8. Apply hot tip with solder wherever required in the PCB Board.
9. Cut the excess components lead with the component cutter.
10. Apply the IPA again and clean the PCB
11. Using the multimeter and check the continuity.

Circuit diagram

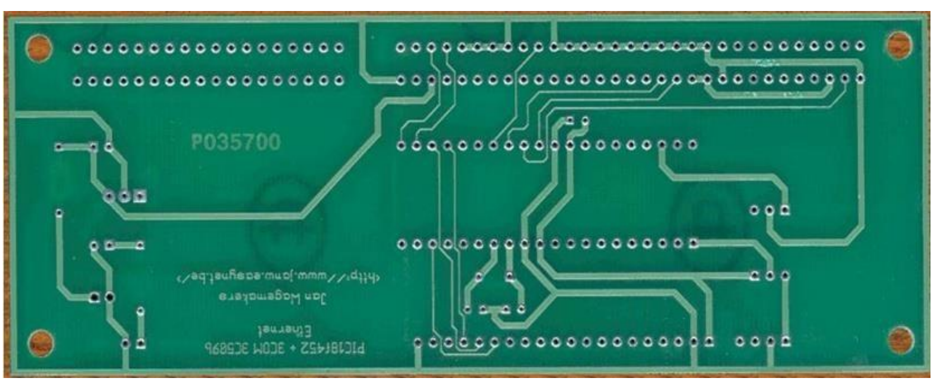
Designed PCB



Back side of the PCB



Front side of the PCB



De-soldering

1. Place the tip of the soldering iron on the joints until the solder is melt.
2. Using desoldering pump or desoldering wik remove the molten state.
3. On the components side using tweezer remove the desoldered components.

Result:

CHARACTERISTICS OF PN-JUNCTION DIODE

Ex.No: 2 **Date**

Aim

To determine the forward and reverse characteristics of a PN diode and to calculate cut-in voltage, forward resistance and reverse resistance.

Apparatus Required

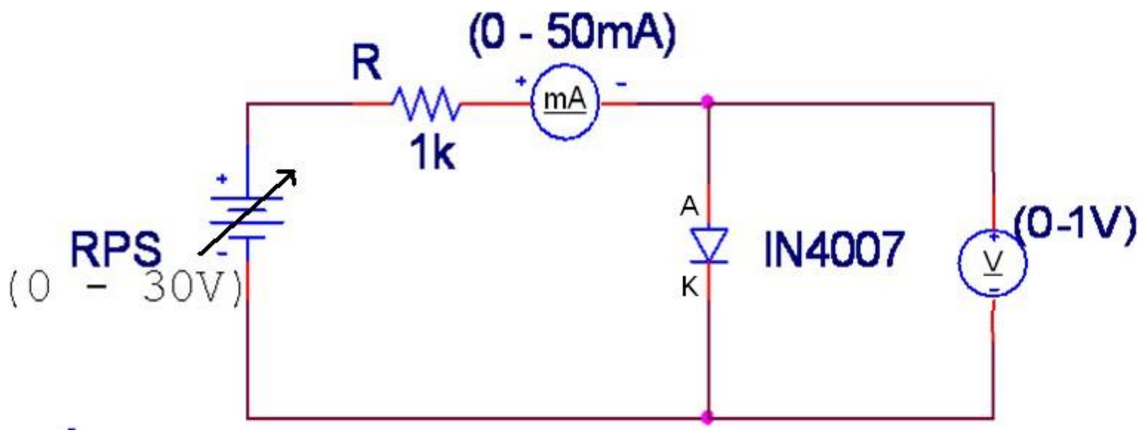
S.No	Item	Range	Qty
1.	Diode	IN4007	1
2.	Resistor	1KΩ	1
3.	Voltmeter	(0-1V)Mc	1
4.	Ammeter	(0-30mA),Mc(0-500	1
5.	RPS	(0-30)V	1

Theory

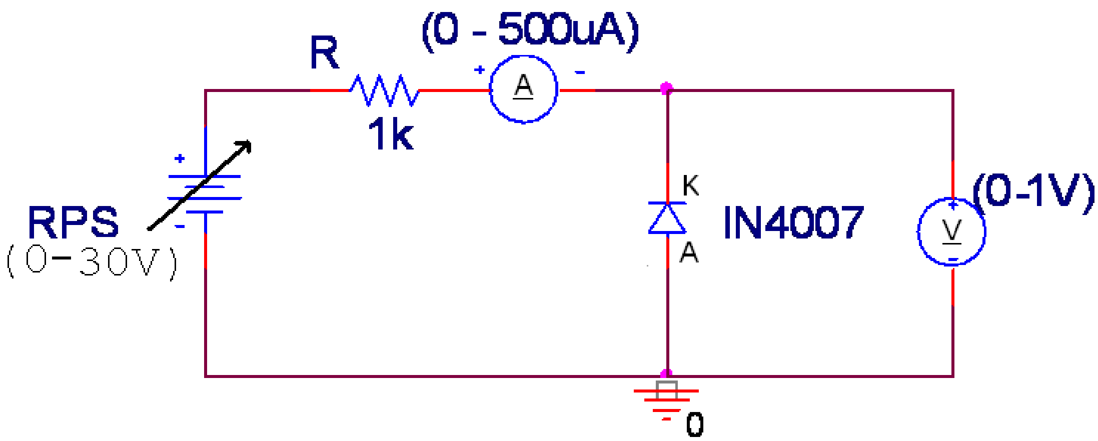
A diode is a PN junction formed by a layer of a P type and layer of N type semiconductors. Once formed the free electrons in the N region diffuse across the junction and combine with holes in P region and so a depletion Layer is developed. The depletion layer consists of ions, which acts like a barrier for diffuse of charged beyond a certain limit. The difference of potential across the depletion layer is called the barrier potential. At 2.5 degree the barrier potential Approximately equal 0.7v foe Silicon diode and 0.3V for Germanium diode. When the junction is forward biased, the majority carrier acquired sufficient energy to overcome the barrier and the diode conducts. When the junction is Reverse Biased the depletion layer widens and the barrier potential increases. Hence the majority carrier cannot cross the junction and the diode does not conduct. But there will be a leakage current due to minority carrier.

Circuit Diagram

Froward Bias



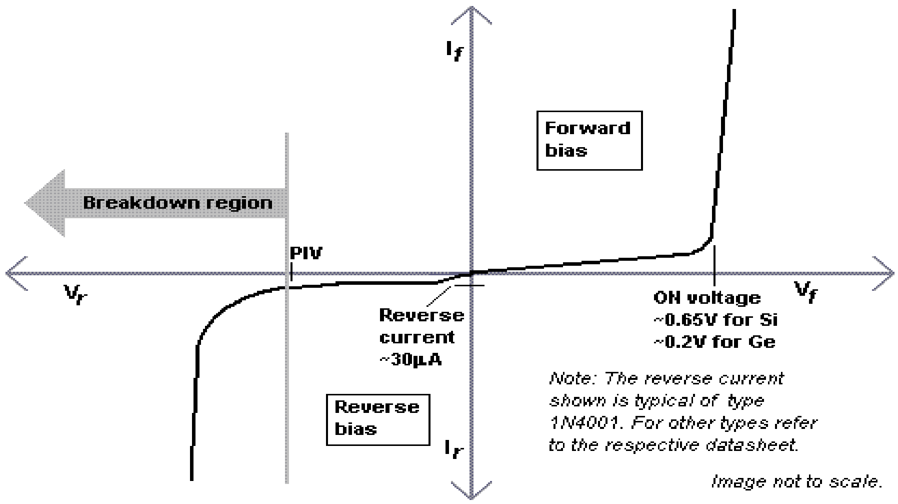
Reverse Bias



Symbol

Model Graph

V-I Characteristics



Tabular Column

Forward Bias

Voltage (Volts)	Current (mA)

Procedure

Forward Bias

The connections are made as per the circuit diagram. The positive terminal of power supply is connected to anode of the diode and negative terminal to cathode of the diode. Forwardvoltage V_f across the diode is increased in small steps and the forward current is noted. The reading is tabulated. A graphs is drawn between V_f and I_f.

Reverse Bias

The connection as made as per the circuit diagram for reverse bias the positive terminal of the power supply is connected to cathode and negative terminal to anode of the diode. The power supply is switched ON, the reverse bias voltage V_f is increased in steps and reverse current I_r is noted in each steps. The readings are tabulated. A graph is drawn V_r and I_r .The reverse characteristics is approximately as straight line, inverse of the slope give the reverse resistance.

Reverse Bias

Voltage (Volts)	**Current (µA)**

Result: Thus the characteristics of PN-Junction diode was drawn. And found the values as

Forward resistance ……… Reverse resistance……Cut-in Voltage ……..

CHARACTERISTICS OF ZENER DIODE

Ex.No: 4 **Date**

Aim

To plot the VI Characteristics of a Zener diode.

Apparatus Required

S.No	Item	Range	Qty
1.	ZENER Diode	IN4007	1
2.	Resistor	1KΩ	1
3.	Voltmeter	(0-1V)Mc	1
4.	Ammeter	(0-30mA),Mc(0-500	1
5.	RPS	(0-30)V	1

Theory: -

The circuit diagram to plot the VI characteristics of a zener diode is shown. Zener doide is a special diode with increased amounts of doping. This is to compensate for the damage that occurs in the case of a pn junction diode when the reverse bias exceeds the breakdown voltage and thereby current increases at a rapid rate.

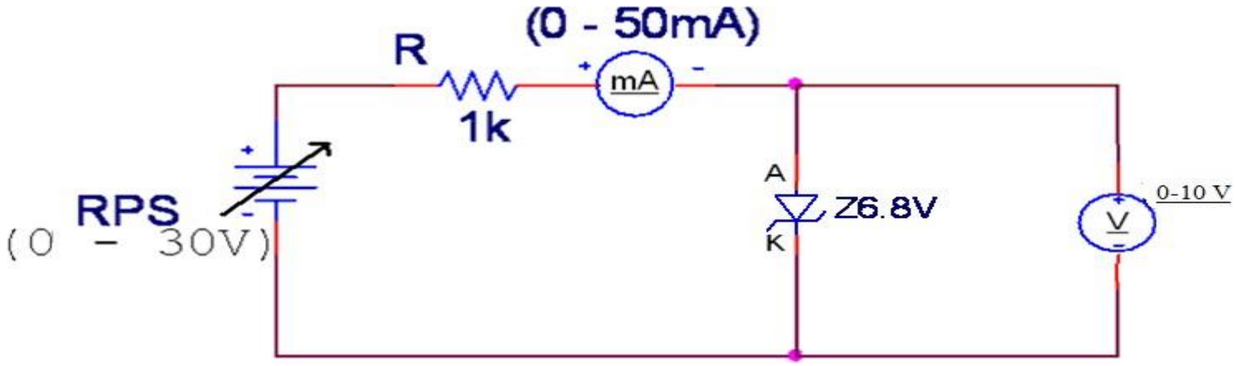
Applying a positive potential to the anode and a negative potential to the cathode of the zener diode establishes a forward bias condition. The forward characteristic of the zener diode is same as that of a pn junction diode i.e. as the applied potential increases

The current increases exponentially. Applying a negative potential to the anode and positive potential to the cathode reverse biases the zener diode.

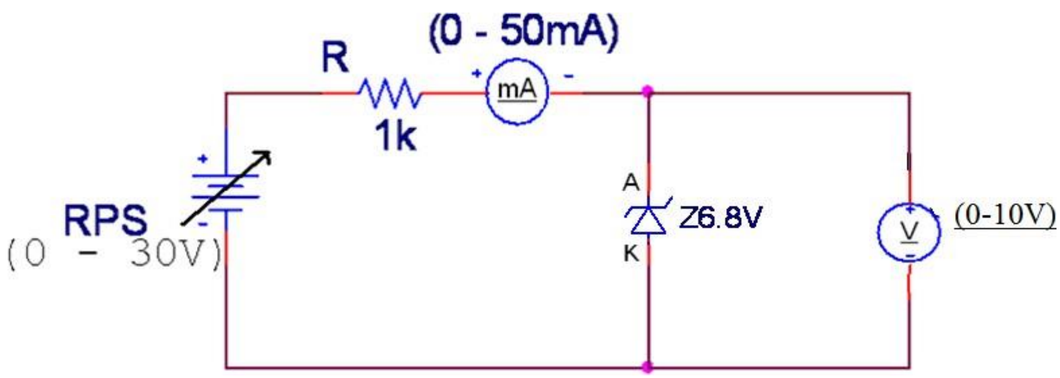
As the reverse bias increases the current increases rapidly in a direction opposite to that of the positive voltage region. Thus under reverse bias condition breakdown occurs.

Circuit Diagram

Forward Bias



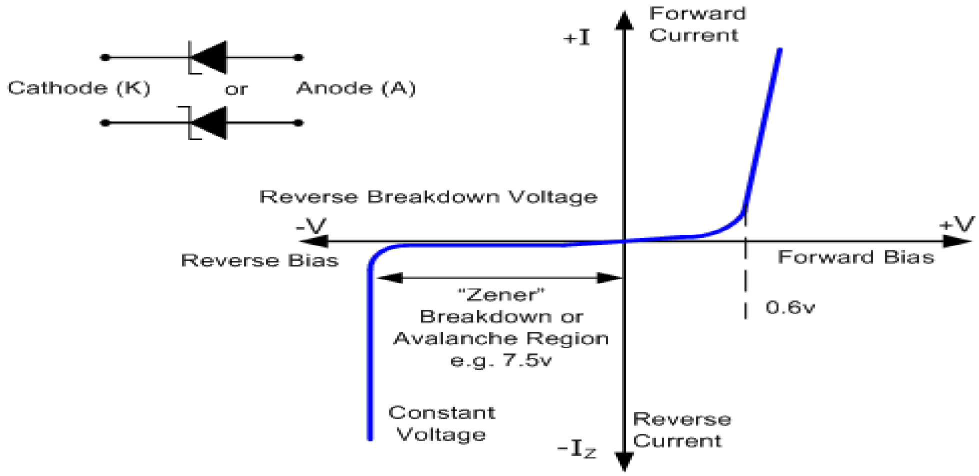
Reverse Bias:



Identification

Modal Graph

V-I Characteristics



Tabular Column

Forward Bias

Voltage (Volts)	Current (mA)

Procedure

Forward Bias

1. The connections are made as per the circuit diagram.
2. The positive terminal of power supply is connected to anode of the diode and negative terminal to cathode of the diode.
3. Forward voltage V_f across the diode is increased in small steps and the forward current is noted.
4. The reading is tabulated.
5. A graphs is drawn between V_f and I_f.

Reverse Bias

1. The connection as made as per the circuit diagram for reverse bias
2. The positive terminal of the power supply is connected to cathode and negative terminal to anode of the diode.
3. The power supply is switched ON
4. The reverse bias voltage V_f is increased in steps and reverse current I_r is noted in each steps.
5. The readings are tabulated.
6. A graph is drawn V_r and I_r .

The reverse characteristics is approximately as straight line, inverse of the slope give the reverse resistance

Reverse Bias

Voltage (Volts)	Current (μA)

Result

Thus the characteristics of PN-Junction diode was drawn.

Forward resistance :…………………………..
Reverse resistance :…………………………...
Reverse Breakdown Voltage :……………………………

VERIFICATION OF LOGIC GATES

Ex.No: 6 **Date**

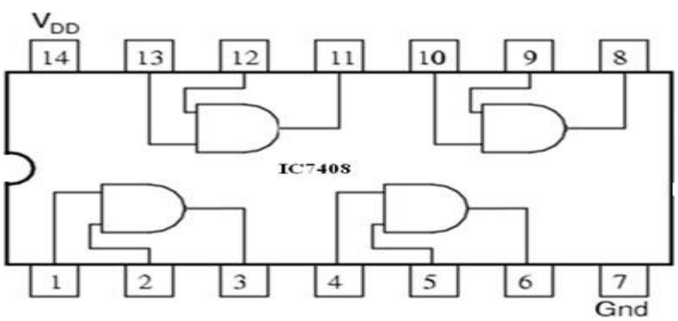
Aim:

To study different logic gates and verify its truth table for AND, OR, NOT, NAND, EX-OR gates.

Apparatus Required:

S.No	Item	Specification	Quantity
1	Digital IC trainer kit	-------	1
2	IC 7432(OR)	QUAD	1
3	IC 7408(AND)	QUAD	1
4	IC 7404(NOT)	INVERTER	1
5	IC 7402(NOR)	QUAD	1
6	IC 7486(EX-OR)	QUAD	1
7	IC 7400(NAND)	QUAD	1
8	Connecting wires	------	------

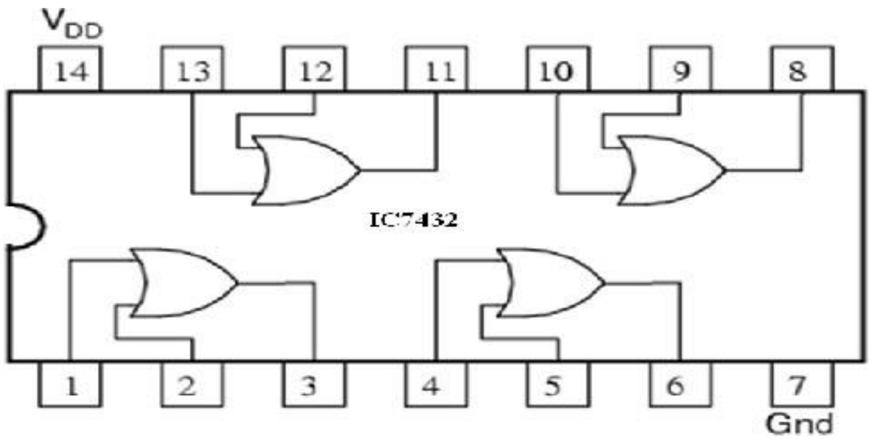
Pin Diagram: (AND GATE)



Truth table

A	B	Y=A.B
0	0	0
0	1	0
1	0	0
1	1	1

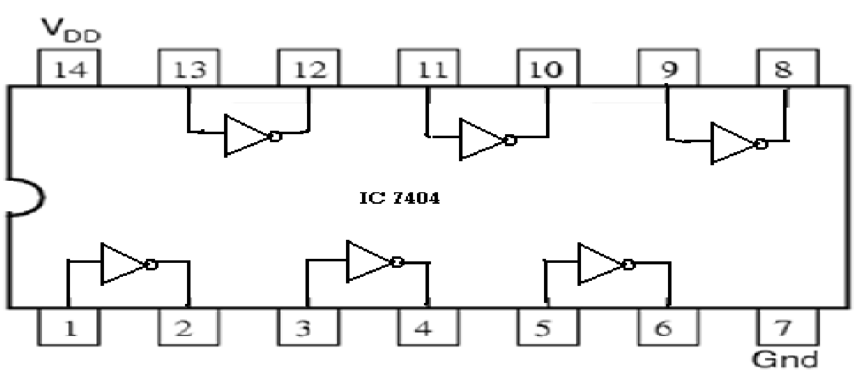
Pin Diagram : (OR GATE)



Truth table

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

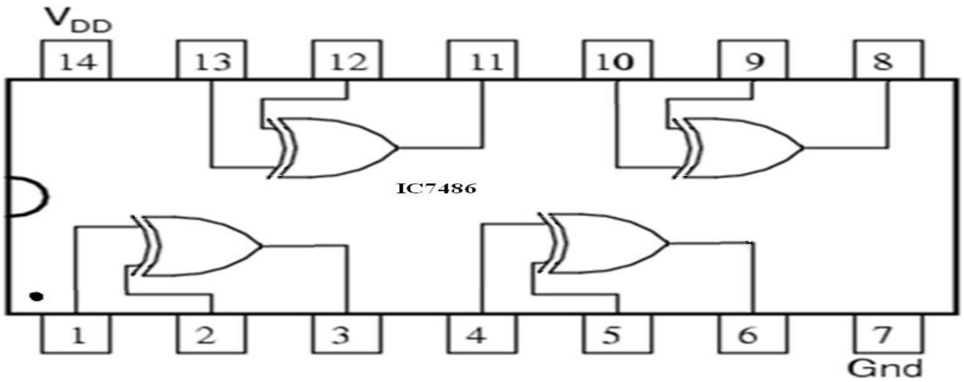
Pin Diagram: (NOT GATE)



Truth table

A	**$Y=\overline{A}$**
0	1
1	0

Pin Diagram: (EX - OR GATE)



Truth Table

A	B	Y=A (+) B
0	0	0
0	1	1
1	0	1
1	1	0

Procedure

1. The connection are given as per the circuit diagram
2. Input are given to the circuits making high '1' i.e +5V supply to 14th pin and low '0'i.e. GND to the 7th pin of the gate IC
3. Depending upon the truth table, if the LED glow it represent 1 and else it represents '0'
4. Verify the truth table as given
5. Repeat the procedure steps for different gates

Result :

Thus the truth tables for the logic gates are verified using IC trainer kit

Clipper and Clampers Circuits

Ex.No: 3 **Date**

Aim:

To realize different clipping and clamping circuits and observe the waveforms.

Apparatus Required:

S.No	Item	Specification	Quantity
1	Step Down Transformer	220 V/12 V	1
2	Diode	IN4007	1
3	Resistor	1KΩ, 100 KΩ	1,1
4	Capacitor	1 micro Farad	1
5	RPS	(0-30) V	1
6	CRO		1
7	Connecting wires	------	------

THEORY

Clipping Circuits

Clipping circuits are nonlinear wave shaping circuits. A clipping circuit is useful to cutoff the positive or negative portions of an input waveform. Clipping circuits are also known as voltage limiters or slicers.

Positive clipper

The positive half cycle is clipped by diode and only the drop across diode will appearacross the load. During negative half cycle, the diode does not conduct and the voltage acrossR_L is given by

$$V_L = V_S \frac{R_L}{R_L + R}$$

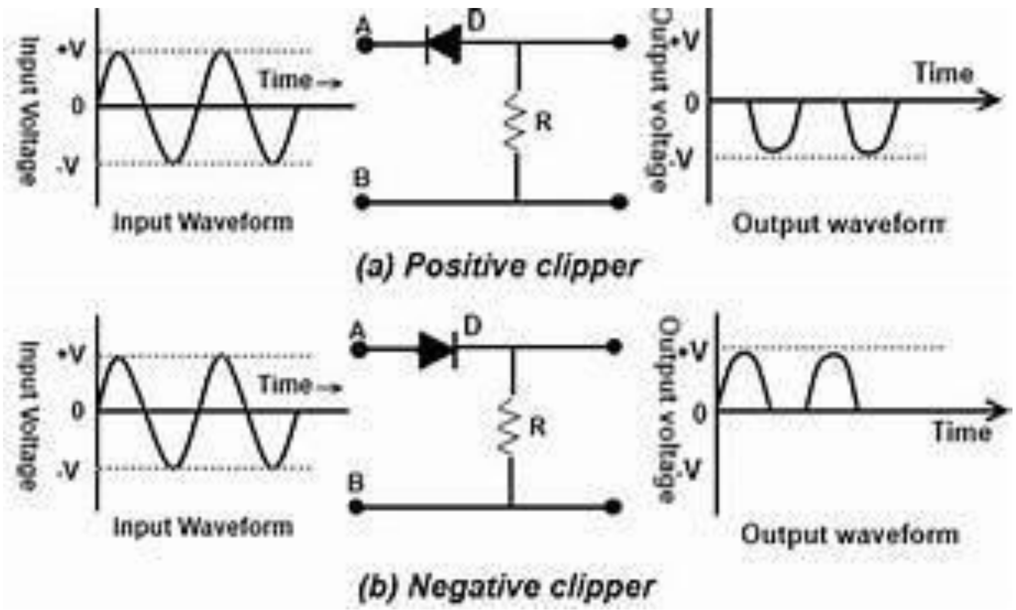
Since $R_L >> R$, the output voltage will be close to input voltage during negative half cycle.

Negative clipper

The negative half cycle is clipped by diode and only the drop across diode will appearacross the load. During positive half cycle, the diode does not conduct and the voltage acrossR_L is given by

$$V_L = V_S \frac{R_L}{R_L + R}$$

Since $R_L >> R$, the output voltage will be close to input voltage during the positive half
cycle

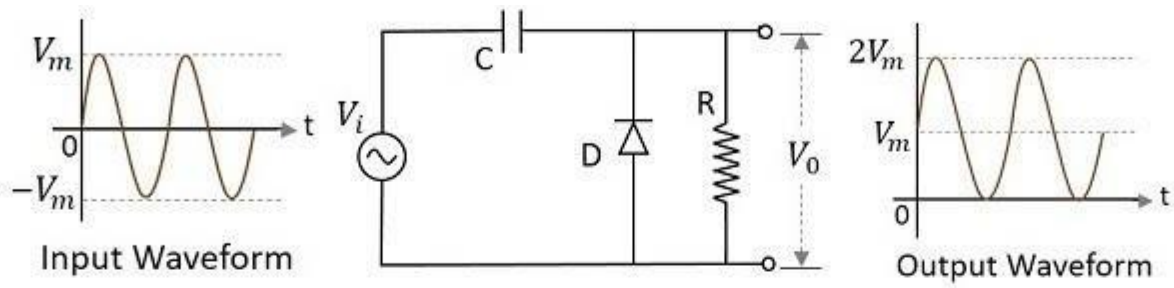


(a) Positive clipper

(b) Negative clipper

Procedure

1. The connections are made as per the circuit diagram.
2. Input AC Voltage is Given to the Circuit
3. The Output is viewed in CRO.
4. A graphs is drawn between Vm and t.



Positive Clamper circuit

Procedure

5. The connections are made as per the circuit diagram.
6. Input AC Voltage is Given to the Circuit
7. The Output is viewed in CRO.
8. A graphs is drawn between Vm and t.

Result :

Thus the Clipper and Clamper Circuits are verified and the Output is drawn in Graph.

Voltage Regulator – Zener Diode

Ex.No: 5 **Date**

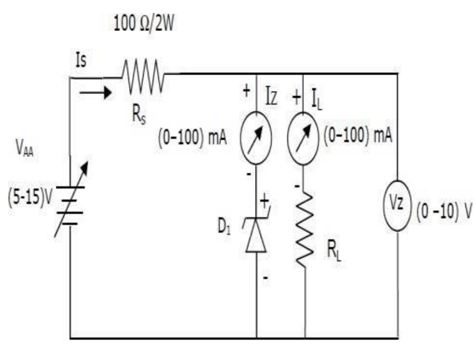
Aim:

To study zener diode as voltage regulator

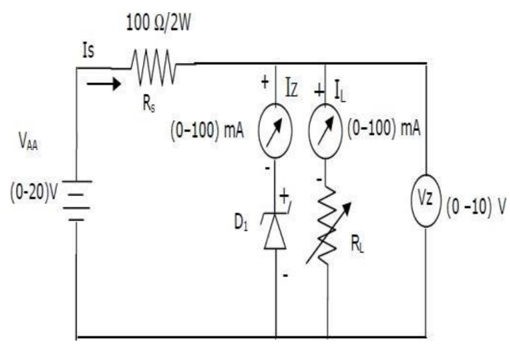
Apparatus Required:

S.No	Item	Specification	Quantity
1	Step Down Transformer	220 V/12 V	1
2	Zener Diode	IN4007	1
3	Resistor	1KΩ, 100 KΩ	1,1
4	Voltmeter	0-10 V	1
5	Ammeter	0-100mA)	2
6	RPS	(0-30) V	1
7	CRO		1
8	Connecting wires	------	------

CIRCUIT DIAGRAM:



Line Regulation: Zener Regulator



Load Regulation: Zener Regulator

THEORY:

Zener diode is a P-N junction diode specially designed to operate in the reverse biased mode. Itis acting as normal diode while forward biasing. It has a particular voltage known

as break down voltage, at which the diode break downs while reverse biased. In the case of normal diodes the diode damages at the break down voltage. But Zener diode is specially designed to operate in thereverse breakdown region.

The basic principle of Zener diode is the Zener breakdown. When a diode is heavily doped, it's depletion region will be narrow. When a high reverse voltage is applied across the junction, therewill be very strong electric field at the junction. And the electron hole pair generation takesplace. Thus heavy current flows. This is known as Zener break down.

So a Zener diode, in a forward biased condition acts as a normal diode. In reverse biased mode, after the break down of junction current through diode increases sharply. But the voltage acrossit remains constant. This principle is used in voltage regulator using Zener diodes

The figure shows the zener voltage regulator, it consists of a current limiting resistor RS connected in series with the input voltage Vs and zener diode is connected in parallel with the load RL in reverse biased condition. The output voltage is always selected with a breakdown voltage Vz of the diode.

e input source current, IS = IZ + IL………………………. (1)

The drop across the series resistance, Rs = Vin – Vz…………(2)

And current flowing through it, Is = (Vin – VZ) / RS……………………(3)

From equation (1) and (2), we get, (Vin - Vz)/Rs = Iz +IL…………………(4)

Regulation with a varying input voltage (line regulation): It is defined as the change in regulated voltage with respect to variation in line voltage. It is denoted by 'LR'.

In this, input voltage varies but load resistance remains constant hence, the load current remains constant. As the input voltage increases, form equation (3) Is also varies accordingly. Therefore, zener current Iz will increase. The extra voltage is dropped across the Rs. Since, increased Iz willstill have a constant Vz and Vz is equal to Vout.

The output voltage will remain constant. If there is decrease in Vin, Iz decreases as load current remains constant and voltage drop across Rs is reduced. But even though Iz may change, Vz remains constant hence, output voltage remains constant.

Regulation with the varying load (load regulation): It is defined as change in load voltage with respect to variations in load current. To calculate this regulation, input voltage is constant and output voltage varies due to change in the load resistance value.

Consider output voltage is increased due to increasing in the load current. The left side of the equation (4) is constant as input voltage Vin, IS and Rs is constant. Then as load current changes,the zener current Iz will also change but in opposite way such that the sum of Iz and IL will remain constant. Thus, the load current increases, the zener current decreases and

sum remain constant. Form reverse bias characteristics even Iz changes, Vz remains same hence, and output voltage remains fairly constant.

PROCEDURE:-

A) Line Regulation:

1. Make the connections as shown in figure below.
2. Keep load resistance fixed value; vary DC input voltage from 5V to 15V.
3. Note down output voltage as a load voltage with high line voltage 'VHL' and as a loadvoltage with low line voltage 'VLL'.

4. Using formula, % Line Regulation = (VHL-VLL)/ VNOM x100, where VNOM = the nominalload voltage under the typical operating conditions. For ex. VNOM = 9.5 ± 4.5 V

B) Load Regulation:

1. For finding load regulation, make connections as shown in figure below.
2. Keep input voltage constant say 10V, vary load resistance value.

3. Note down no load voltage 'VNL' for maximum load resistance value and full load voltage'VFL' for minimum load resistance value.
4. Calculate load regulation using, % load regulation = (VNL-VFL)/ VFL x100

OBSERVATION TABLE:-

Result:

Thus the Zener Voltage Regulator was designed