SATHYABAMA UNIVERSITY

(Established under Section 3 of the UGC Act, 1956)

(A CHRISTIAN MINORITY INSTITUTION)

Jeppiaar Nagar, Rajiv Gandhi Road, Chennai – 600 119, Tamilnadu. India.

ISO 9001 REGISTERED
MGMT. SYS. RvA C024
DNV Certification B.V., The Netherlands

ELECTRONIC DEVICES LAB MANUAL

Name: ………………………………….. Roll No.: ……………

Semester: **I** Branch: **ECE** Code**: SEC4051**

FACULTY OF ELECTRICAL AND ELECTRONICS ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SATHYABAMA UNIVERSITY

Jeppiaar Nagar, Rajiv Gandhi Road, Chennai – 600 119.

LIST OF EXPERIMENTS

SEC4051 - ELECTRONIC DEVICES LAB

1. Study of circuit components and equipment's (Component identification, color coding, checking diode, BJT, FET, study of CRO, Audio Oscillator, Multimeter, LCR meter)

2. Characteristics of Semiconductor diode and Zener diode

3. Characteristics of CE configuration (h- parameter determination)

4. Characteristics of CB configuration

5. Characteristics of JFET

6. Characteristics of CC configuration

7. Characteristics of SCR & UJT

8. Characteristics of Diac&Triac

9. Characteristics of MOSFET

10. Characteristics of Photo transistor

11. Characteristics of LDR

12. Switching CharacteristicS of BJT

13. Clippers and Clampers

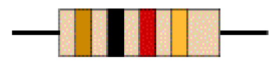
14. Voltage Multipliers

INDEX

INTRODUCTION

PASSIVE COMPONENTS: Components which do not require power supply for its operation are called Passive components. Resistors, Capacitors and Inductors are the important passive components used in electronics. None of these elements (except electrolytic capacitor) has polarity.
Resistors: Resistors opposes the flow of electric current

Resistor symbol



View of the resistor

Example: Resistance is measured in **ohms** (Ω).

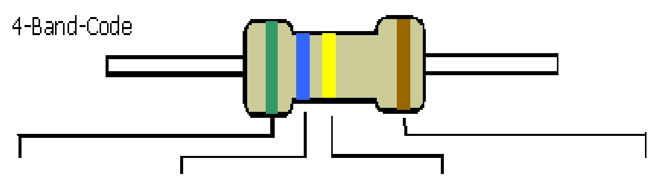
1 Ω is quite small so resistor values are often given in kΩ and MΩ.

1 kΩ = 1000 Ω   1 MΩ = 1000000Ω.

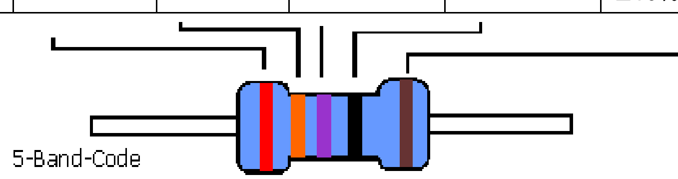
Resistor values are normally shown using colored bands. Each color represents a number as shown in the table.

Most resistors have 4 bands:

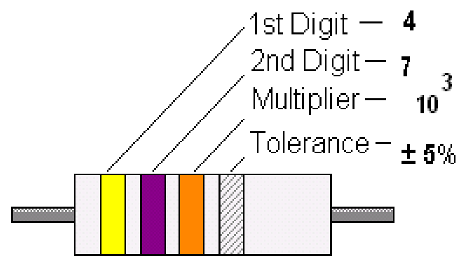
- The **first band** gives the **first digit**.
- The **second band** gives the **second digit**.
- The **third band** indicates the **number of zeros** or **Multiplier**
- The **fourth band** is used to showS the tolerance



Colour	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	NIL	1 Ω	± 1%
Brown	1	1	1	10 Ω	±2%
Red	2	2	2	100 Ω	
Orange	3	3	3	1K Ω	
Yellow	4	4	4	10K Ω	
Green	5	5	5	100K Ω	± 0.5%
Blue	6	6	6	1 MΩ	±0.25%
Violet	7	7	7	10 MΩ	±0.10%
Gray	8	8	8		±0.05%
White	9	9	9		
Gold					±5%
Silver					±10%



This resistor has **yellow, violet, orange** and **gold** bands.



So its value is **47× 10^3 = 47 000 Ω = 47 KΩ.**
On circuit diagrams the Ω is usually omitted and the value is written **47**

Capacitors

Capacitors store electric charge. They are used with resistors in timing circuits because it takes time for a capacitor for charging .They are used to for smooth varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC (changing) signals but they block DC (constant) signals.

Capacitance: This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, symbol F. However 1F is very large, so prefixes are used to show the smaller values. Three prefixes (multipliers) are used, µ (micro), n (nano) and p (pico):

- µ means 10^{-6} (millionth), so 1000000µF = 1F
- n means 10^{-9} (thousand-millionth), so 1000nF = 1µF
- p means 10^{-12} (million-millionth), so 1000pF = 1nF

There are many types of capacitor but they can be split into two groups, **polarised** and **unpolarised**. Each group has its own circuit symbol.

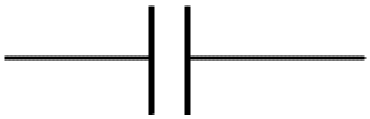
Polarised capacitors or Electrolytic Capacitors (large values, 1µF +)

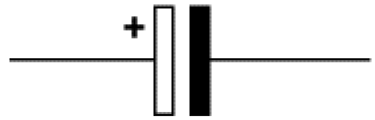
Electrolytic capacitors are polarised and **they must be connected the correct way round**, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

There are two designs of electrolytic capacitors; **axial** where the leads are attached to each end (220µF in picture) and **radial** where both leads are at the same end (10µF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board.

It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating.

The voltage rating can be quite low (6V for example) and it should always be checked, when selecting an electrolytic capacitor. If the project parts list does not specify a voltage, choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits



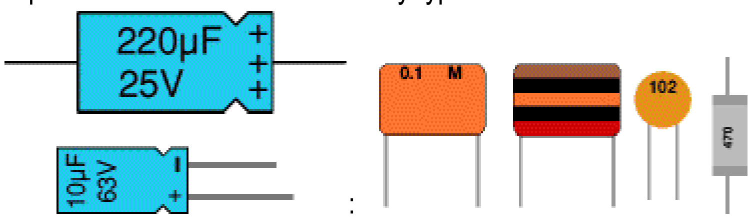


Unpolarised capacitors **Polarised capacitors**

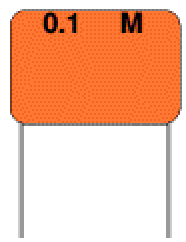
Capacitor symbol

Unpolarised capacitors (small values, up to 1µF)

Small value capacitors are unpolarised and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems



Capacitor component view



For example **0.1** means **0.1µF** = **100nF.**

104 means **0.1 µF**

103 means **0.01 µF**

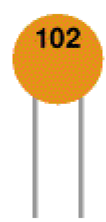
102 means **0.001 µF**

204 means**0.2µF**

Sometimes the multiplier is used in place of the decimal point:

For example:

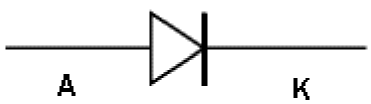
4n7 means **4.7nF.**

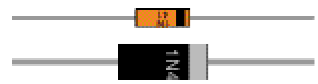


0.01 µF

ACTIVE COMPONENTS: Components which requires power supply for its operation are called active components. Diode, Transistor, UJT, FET, IC'S etc. are the important active components used in electronics.

3.1. Diodes: Diode is two terminal devices. Anode and Cathode are the two electrodes (denoted by A and K respectively) and the later is indicated by any distinct mark on the body of the component. Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current flows. Diodes are the electrical version of a valve and early diodes were actually called valves. In figure [diode component view] the ring side of the diode terminal is called **cathode** and other terminal is **anode.**





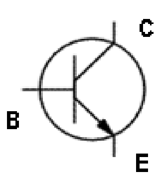
Diode symbol **Diode component view** :

Transistors

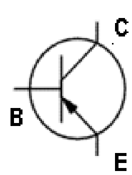
Function: Transistors perform amplification, for example they can be used to amplify the small output current from a logic IC so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to amplify voltage. A transistor may be used as a switch (either fully ON with maximum current, or fully OFF with no current) and as an amplifier (always partly ON).

Types of transistor

There are two types of standard transistors, **NPN** and **PNP**, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN because this is the easiest type to make from silicon. If you are new to electronics it is best to start by learning how to use NPN transistors. The leads are labeled as **base** (B), **collector** (C) and **emitter** (E). These terms refer to the internal operation of a transistor but they are not much help in understanding how a transistor is used, so just treat them as labels!



NPN Transistor



PNP Transistor

Transistor symbol

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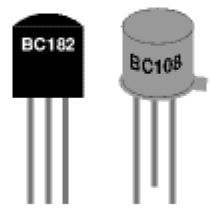
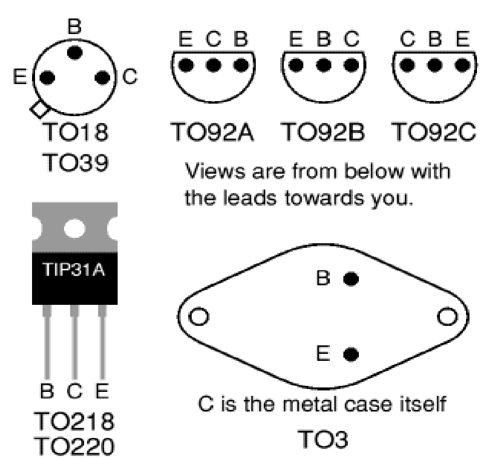


Transistor component view

BJT, FET, MOSFET all comes under the category of transistor. But in normal usage transistor straightaway means BJT. Some of the commonly used transistors' package details are illustrated in the bellow figure. (Using this we can identify the terminals only-not its type)



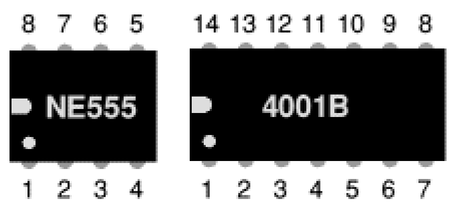
Transistor leads for some common case styles

Integrated Circuits

Integrated Circuits are usually called ICs or chips. They are complex circuits which have been etched onto tiny chips of semiconductor (silicon). The chip is packaged in a plastic holder with pins spaced on a 0.1" (2.54mm) grid which will fit the holes on strip board and breadboards. Very fine wires inside the package link the chip to the pins.

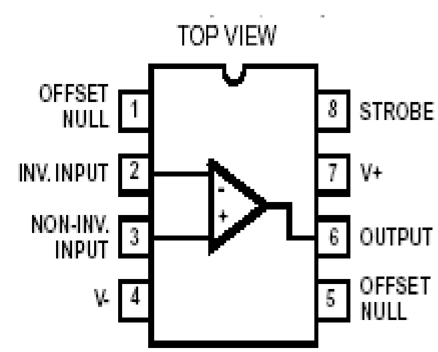
Pin numbers: The pins are numbered anti-clockwise around the IC (chip) starting near the **notch or dot**. The diagram shows the numbering for 8-pin and 14-pin ICs, but the principle is the same for all sizes.

The 555 IC Timer: The 8-pin 555 timer IC is used in many projects, a popular version is the NE555. Most circuits will just specify '555 timer IC' and the NE555 is suitable for these. The 555 output (pin 3) can sink and source up to 200mA.To check the 555 IC timer the following procedure has to be followed. Apply 5V DC to pin no.8 and ground connection to pin no.1. Now the voltage at pin no. 5 will be 2/3 Vcc (3.3V) hence the Timer IC is in good condition otherwise the IC has to be changed.

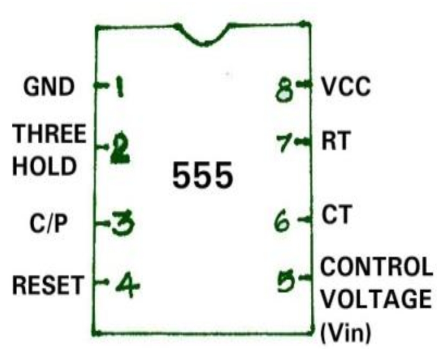


Operational Amplifiers IC-741

Pin-Diagram of IC-741.IC-741 is a 8-pin IC. Every IC should be supplied with positive and negative dc voltages of +12 and –12 volts respectively. +12V should be supplied to pin-7 and –12V to pin-4. Pin-2 is the inverting input pin and Pin-3 is the non inverting input pin. Output can be measured at the output pin-6 with respect to the breadboard ground. Pins 1 and 5 are used for output offset voltage compensation. These two pins are not required for normal application. To check the Op-Amp .IC , apply Sine wave of (1V,1KHz) at pin no.2, +12V should be supplied to pin-7 and –12V to pin-4.If IC is good the output (pin no.6)be a square wave with peaks at +ve Vsat and –ve Vsat, otherwise the IC to be changed.



IC-741 pin details



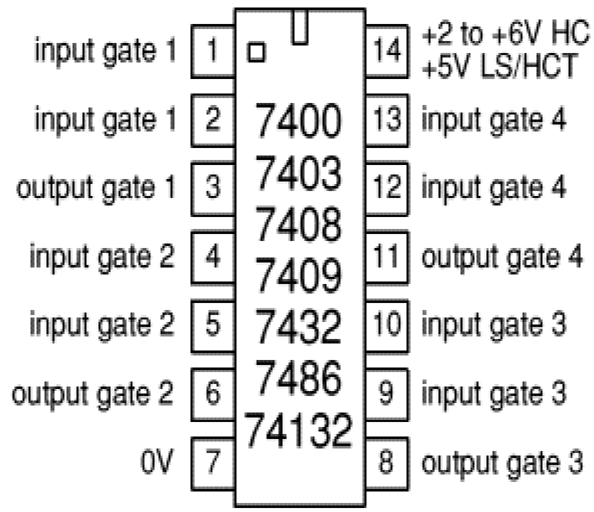
74 Series Logic ICs

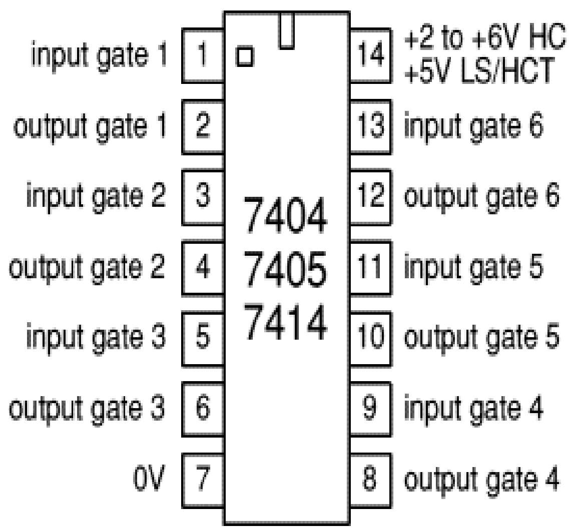
General characteristics There are several families of logic ICs numbered from 74xx00 onwards with letters (xx) in the middle of the number to indicate the type of circuitry, eg 74LS00 The 74LS (Low-power Schottky) family (like the original) uses TTL (Transistor-Transistor Logic) circuitry which is fast but requires more power than later families. The 74 series is often still called the 'TTL series' even though the latest ICs do not use TTL.

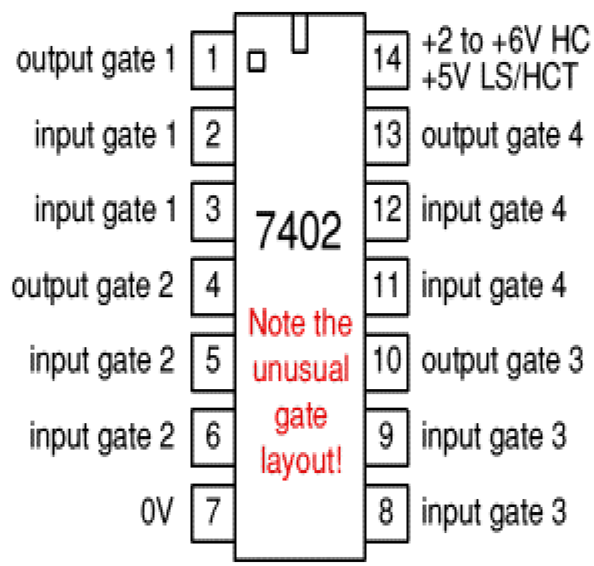
74LS family TTL characteristics:

Quad 2-input gates

- 7400 quad 2-input NAND
- 7402 quad 2-input NOR
- 7404 hex NOT
- 7408 quad 2-input AND
- 7432 quad 2-input OR
- 7486 quad 2-input EX-OR







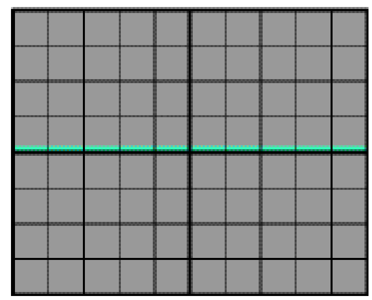
Oscilloscopes (CROs)

An oscilloscope is a test instrument which allows you to look at the 'shape' of electrical signals by displaying a graph of voltage against time on its screen. It is like a voltmeter with the valuable extra function of showing how the voltage varies with time. A reticule with a 1cm grid enables you to take measurements of voltage and time from the screen. The graph, usually called the trac**e**, is drawn by a beam of electrons striking the phosphor coating of the screen making it emit light, usually green or blue. This is similar to the way a television picture is produced.

Setting up an oscilloscope

Oscilloscopes are complex instruments with many controls and they require some care to set up and use successfully. It is quite easy to 'lose' the trace off the screen if controls are set wrongly! There is some variation in the arrangement and labeling of the many controls so the following instructions may need to be adapted for your instrument.

1. **Switch on** the oscilloscope to warm up (it takes a minute or two).
2. Do **not** connect the input lead at this stage.
3. Set the **AC/GND/DC** switch (by the Y INPUT) to **DC**.
4. Set the **SWP/X-Y** switch to **SWP** (sweep).
5. Set **Trigger Level** to **AUTO**.
6. Set **Trigger Source** to **INT** (internal, the y input).
7. Set the **Y AMPLIFIER** to **5V/cm** (a moderate value).
8. Set the **TIMEBASE** to **10ms/cm** (a moderate speed).
9. Turn the time base **VARIABLE** control to **1** or **CAL**.
10. Adjust **Y SHIFT** (up/down) and **X SHIFT** (left/right) to give a **trace across the middle of the screen**, like the picture.
11. Adjust **INTENSITY** (brightness) and **FOCUS** to give a bright, sharp trace.
12. The oscilloscope is now ready to use!



This is what you should see after setting up, when there is no input signal connected

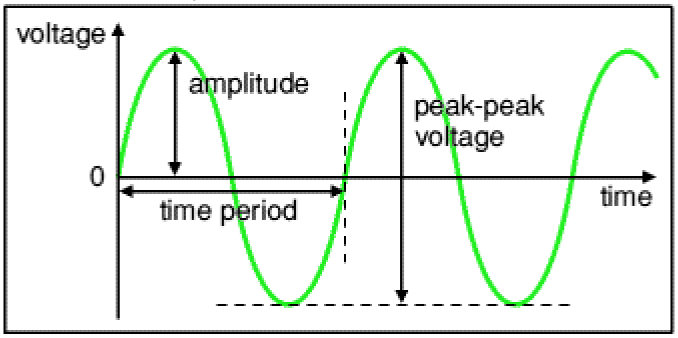
Obtaining a clear and stable trace

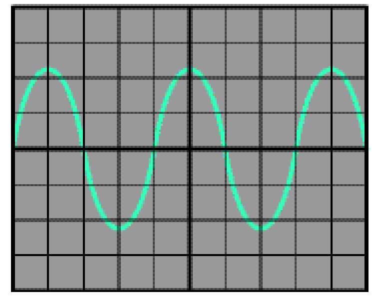
Once you have connected the oscilloscope to the circuit you wish to test you will need to **adjust the controls** to obtain a clear and stable trace on the screen:

- The **Y AMPLIFIER (VOLTS/CM)** control determines the height of the trace. Choose a setting so the trace occupies at least half the screen height, but does not disappear off the screen.
- The **TIMEBASE (TIME/CM)** control determines the rate at which the dot sweeps across the screen. Choose a setting so the trace shows at least one cycle of the signal across the screen.
  Note that a steady DC input signal gives a horizontal line trace for which the time base setting is not critical.
- The **TRIGGER** control is usually best left set to AUTO.
- If you are using an oscilloscope for the first time it is best to start with an easy signal such as the output from an AC power pack set to about 4V.

Measuring voltage and time period

The trace on an oscilloscope screen is a graph of voltage against time. The shape of this graph is determined by the nature of the input signal. In addition to the properties on the graph, there is frequency which is the number of cycles per second. The diagram shows a sine wave but these properties apply to any signal with a constant shape.





The trace of an AC signal with the oscilloscope controls correctly set

Amplitude is the maximum voltage reached by the signal. It is measured in volts, V.

- **Peak voltage** is another name for amplitude.
- **Peak-peak voltage** is twice the peak voltage (amplitude). When reading an oscilloscope trace it is usual to measure peak-peak voltage.
- **Time period** is the time taken for the signal to complete **one cycle**.
  It is measured in **seconds (s)**, but time periods tend to be short so **milliseconds (ms)** and
- **microseconds (μs)** are often used. 1ms = 0.001s and 1μs = 0.000001s.
- **Frequency** is the number of cycles per second.
  It is measured in **hertz (Hz)**, but frequencies tend to be high so **kilohertz (kHz)** and **megahertz (MHz)**are often used. 1kHz = 1000Hz and 1MHz = 1000000Hz.

Voltage

Voltage = distanceincm × volts/cm

Example:peak-peakvoltage=4.2cm×2V/cm=8.4V

amplitude (peak voltage) = ½ × peak-peak voltage = 4.2V

Time period: Time is shown on the horizontal x-axis and the scale is determined by the TIMEBASE (TIME/CM) control. The time period (often just called period) is the time for one cycle of the signal. The frequency is the number of cyles per second, frequency = 1/time period. Ensure that the variable time base control is set to 1 or CAL (calibrated) before attempting to take a time reading.

Time = distance in cm × time/cm

Example: time period = 4.0cm × 5ms/cm = 20ms

and frequency = $^{1}/_{\text{time period}}$ = $^{1}/_{20\text{ms}}$ = 50Hz

Breadboards

The physical diagram of a typical breadboard is as shown in Fig.**A.**This board can be divided into 4 regions. The top and bottom regions marked by red and blue lines represent horizontal short. In these regions, all the pins in a row are shorted internally. In regions 2 and 3 each column is shorted internally. IC should be placed inbetweentheregions2 and 3.

Fig.B two clearly shows the vertically and horizontally shorted regions.

Breadboards are used to test circuits. Wires and components are simply pushed into the holes to form a completed circuit and power can be applied. One of the main advantages of using a breadboard is that the components are not soldered and if they are positioned incorrectly they can be moved easily to a **new** position on the board. On the breadboard (diagram 1) seen opposite, letters are used to identify vertical columns and numbers to identify horizontal rows The red lines on diagram 2 show how some vertical columns and horizontal rows are internally connected. When power is applied to the breadboard current flows along these internal connections Diagram 3 shows how a 380 ohm resistor and an LED are setup on a breadboard. When a 9 volt battery is attached the LED lights. Try replacing the resistor with a higher value such as a 680 ohm resistor. The resistance will be greater and the LED should shine less bright.

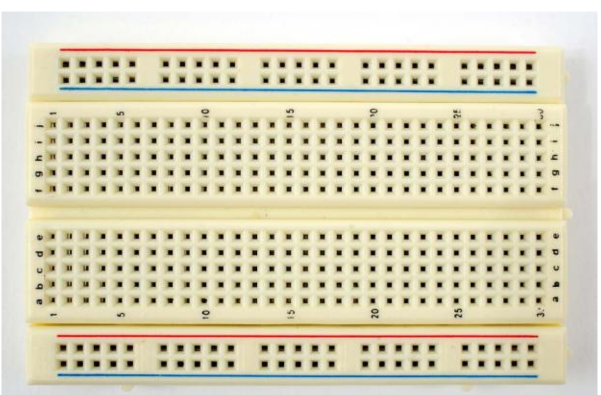


Fig.: **A.**

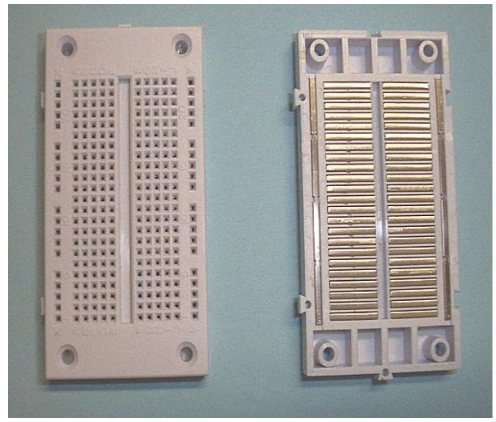
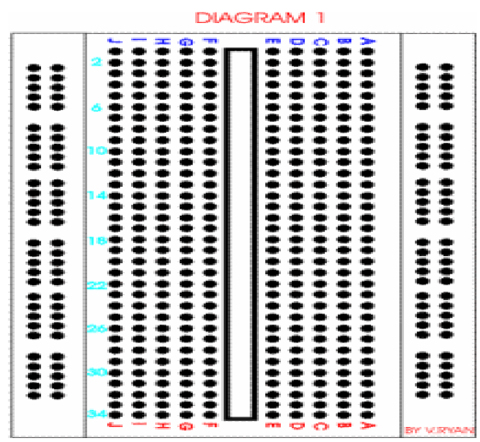
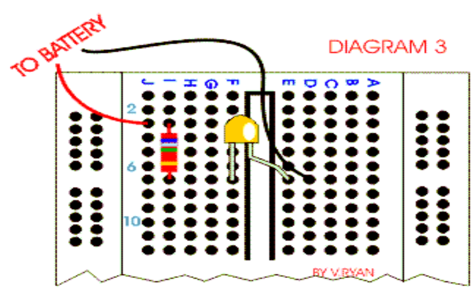
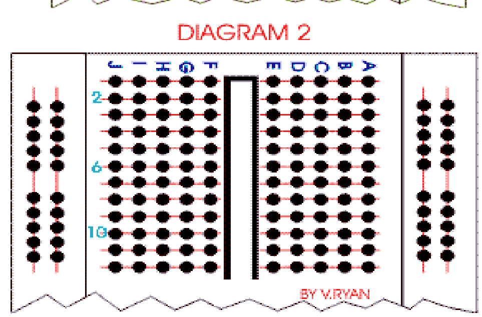


Fig.: B







Expt.No: 1

Date:

STUDY OF ELECTRONIC COMPONENTS

(Identification, color coding, symbols, and checking of electronic components)

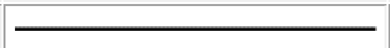
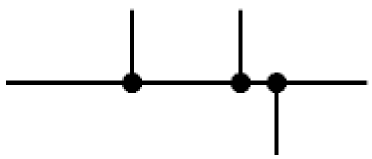
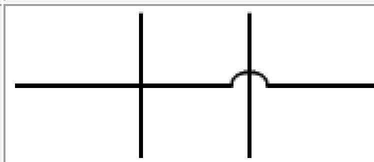
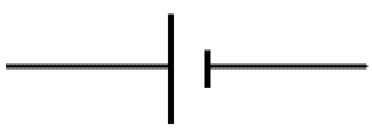
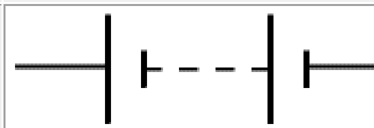
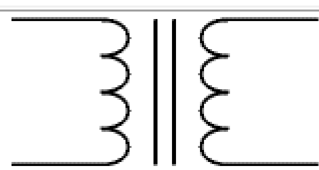
AIM: **1**) To know about the symbols used to specify electronic components.

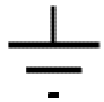
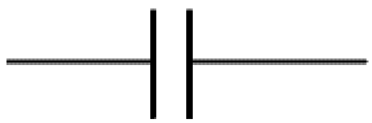
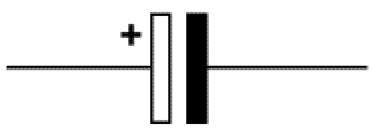
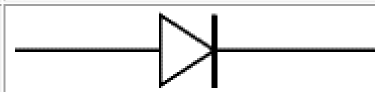
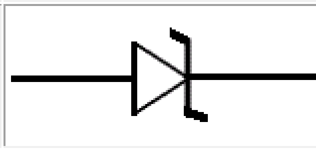
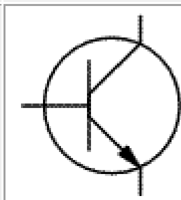
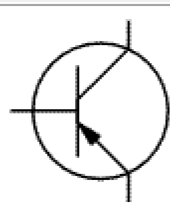
2) To understand the color coding scheme used in resistors and capacitors.

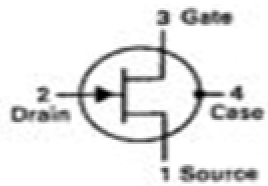
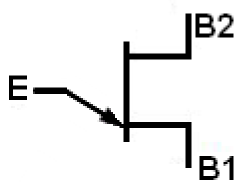
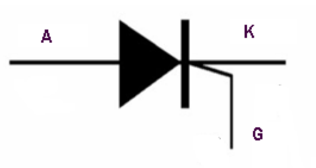
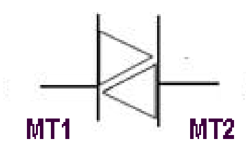
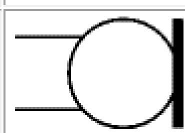
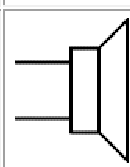
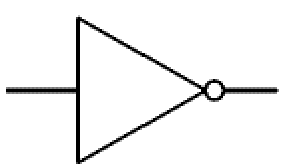
3) To identify the given electronic components

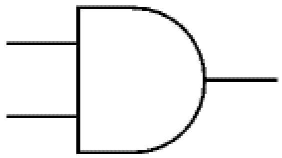
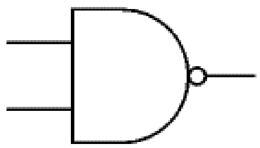
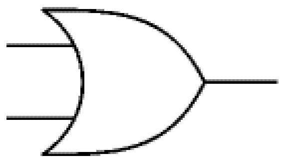
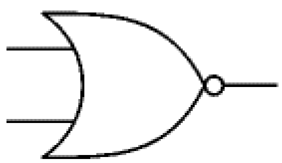
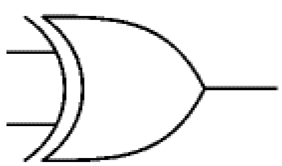
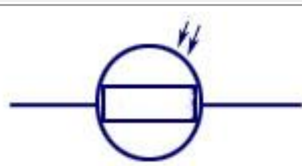
4) To acquire the thorough knowledge about checking of the electronic components

CIRCUITSYMBOLS: Circuit symbols are used in circuit diagrams those show how a circuit is connected together. The actual layout of the components is usually quite different from the circuit diagram. To build a circuit you need a different diagram showing the layout of the parts on. Here we have to discuss some important components and their symbols.

Component	Circuit Symbol	Function of Component
Wire		To pass current very easily from one part of a circuit to another.
Wires joined		A 'blob' should be drawn where wires are connected (joined), but it is sometimes omitted. Wires connected at 'crossroads' should be staggered slightly to form two T-junctions, as shown on the right.
Wires not joined		In complex diagrams it is often necessary to draw wires crossing even though they are not connected. I prefer the 'bridge' symbol shown on the right because the simple crossing on the left may be misread as a join where you have forgotten to add a 'blob'!
Cell		Supplies electrical energy. The larger terminal (on the left) is positive (+). A single cell is often called a battery, but strictly a battery is two or more cells joined together.
Battery		Supplies electrical energy. A battery is more than one cell. The larger terminal (on the left) is positive (+).
DC supply		Supplies electrical energy. DC = Direct Current, always flowing in one direction.
Transformer		Two coils of wire linked by an iron core. Transformers are used to step up (increase) and step down (decrease) AC voltages. Energy is transferred between the coils by the magnetic field in the core. There is no electrical connection between the coils.

Component	Circuit Symbol	Function of Component
Earth (Ground)		A connection to earth. For many electronic circuits this is the 0V (zero volts) of the power supply, but for mains electricity and some radio circuits it really means the earth. It is also known as ground.
Resistor		A resistor restricts the flow of current, for example to limit the current passing through an LED. A resistor is used with a capacitor in a timing circuit. Some publications still use the old resistor symbol: 
Capacitor		A capacitor stores electric charge. A capacitor is used with a resistor in a timing circuit. It can also be used as a filter, to block DC signals but pass AC signals.
Capacitor, polarised		A capacitor stores electric charge. This type must be connected the correct way round. A capacitor is used with a resistor in a timing circuit. It can also be used as a filter, to block DC signals but pass AC signals.
Diode		A device which only allows current to flow in one direction.
Zener Diode		A special diode which is used to maintain a fixed voltage across its terminals.
Transistor NPN		A transistor amplifies current. It can be used with other components to make an amplifier or switching circuit.
Transistor PNP		A transistor amplifies current. It can be used with other components to make an amplifier or switching circuit.

Component	Circuit Symbol	Function of Component
FET		Field effect transistor. [FET] is a semiconductor device that outputs current in proportion to its input voltage. FETs use a small amount of control current to regulate a larger output current.
UJT		Unijunction transistor [UJT] is a voltage-controlled switch that controls current. It has only one junction. The UJT having three terminals an emitter (E) and two bases (B1 and B2). The base is formed by lightly doped n-type bar of silicon. Two ohmic contacts B1 and B2 are attached at its ends
SCR		A silicon-controlled rectifier is a four-layer solid state device that controls current. An SCR consists of four layers of alternating P and N type semiconductor materials (PNPN) with three terminals: an input control terminal (gate), an output terminal (anode), and a terminal common to both the input and output (cathode).
DIAC		Diode alternating current switch [DIAC] is a semiconductor device that can conduct current in either direction, but not until breakdown voltage has been exceeded.
Microphone		A transducer which converts sound to electrical energy.
Loudspeaker		A transducer which converts electrical energy to sound.
NOT		A NOT gate can only have one input. The 'o' on the output means 'not'. The output of a NOT gate is the inverse (opposite) of its input, so the output is true when the input is false. A NOT gate is also called an inverter.

Component	Circuit Symbol	Function of Component
AND		An AND gate can have two or more inputs. The output of an AND gate is true when all its inputs are true.
NAND		An NAND gate can have two or more inputs. The output of an NAND gate is true when all its inputs are true.
OR		An OR gate can have two or more inputs. The output of an OR gate is true when at least one of its inputs is true
NOR		A NOR gate can have two or more inputs. The 'o' on the output means 'not' showing that it is a Not OR gate. The output of a NOR gate is true when none of its inputs are true.
EX-OR		An EX-OR gate can only have two inputs. The output of an EX-OR gate is true when its inputs are different (one true, one false).
Light Dependent Resistor (LDR)		It is abbreviated as **LDR.** Light Dependent Resistor is used to convert light into its corresponding resistance. Instead of directly measuring the light, it senses the heat content and converts it onto resistance.

OBSERVATION:-

To understand the color coding scheme used in resistors and capacitors.

Example 1: For a Carbon **22000 Ohms** or **22 Kilo-Ohms** also known as **22K** at **5%**tolerance:

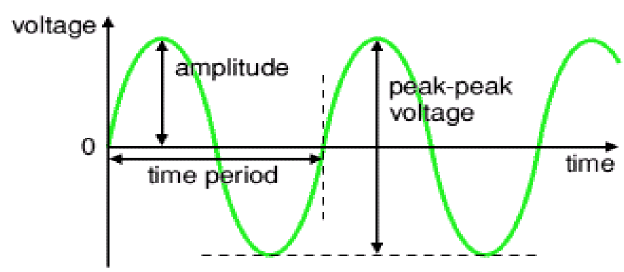
Band 1 = Red, 1st digit
Band 2 = Red, 2nd digit
Band 3 = Orange, 3rd digit, multiply with zeros, in this case 3 zero's
Band 4 = Gold, Tolerance, 5%

Example 2: For a Precision Metal Film **19200 Ohms** or **19.2 Kilo-Ohms**(**19K2)** at 1% tolerance.

Band 1 = Brown, 1st digit
Band 2 = White, 2nd digit
Band 3 = Red, 3rd digit
Band 4 = Red, 4th digit, multiply with zeros, in this case 2 zero's
Band 5 = Brown, Tolerance, 1%
Band 6 = Blue, Temperature Coefficient, 6

Note: If the 3rd band is **gold** it means multiplying by 0.1. Example, **1.2 ohm @ 5%** would be **brown-red-gold-gold**. 12multiplied by 0.1 gives 1.2 ohms. Don't get confused by gold as a resistance or a tolerance value. Just watch the location/position of the band.

Sl. No.	Resistor Color Code Number				Value
	I - Ring	II - Ring	III - Ring	I V- Ring	
1					
2					
3					
4					
5					



TO MEASURE VOLTAGE AND TIME PERIOD IN CRO

Voltage [V_M] = Y axis +ve peak value × Volts/cm

(OR)

V_M= ½ [Y- axis peak-peak value × Volts/cm]

Time [T] = X-axis one Cycle **(ON Time + OFF Time)**Duration x Time/ Division in **ms or µs**

Sl.No.	Waveform	Time		Total Time Period T in Sec.	Frequency $F=\frac{1}{T}$ in Hz	Amplitude V_M in Volts
		ON Time	OFF Time			
1	Sine Wave					
2	Triangular Wave					
3	Square Wave					

To identify the given electronic components

1) The transistor can be considered as two diodes ieThe base emitter junction forms one diode and the collector base junction forms the other.
2) Individually check both the junctions and confirm both are OK.
3) Also there must not be any collector emitter short.
4) If we know the type and terminals of the transistor exactly then it can be straightaway inserted in the slot provided in the digital multimeter (and the rotary switch of the meter pointing hfe) and read the value .If the hfe value is in between 50 and 300 the transistor is OK.

To acquire the thorough knowledge about checking of the electronic components

Diode :

1) Keep the Multimeter in resistance or continuity mode.
2) Connect the two test probe on either side of the diode.
3) Either it reads low resistance or shows high resistance.
4) Reverse the probe connections
5) Now the meter should read opposite to that of the step 3
i) If it is so then the diode is OK,
ii) In this case while showing the low resistance the electrode connected to the positive probe is anode.
6) If the meter reads in the same way for both the connections then the diode is useless.
I) If it is low resistance, the diode is said to be shorted.
ii) If it is high then the diode is open

Passive components:

1) For measuring resistors multimeters can be used.
2) For measuring capacitors and inductors RLC meters, bridges are available.
3) i) For Electrolytic capacitor connect the two probes of the multimeterto the either end of the device. The meter immediately flash to low resistance and slowly returns to the high value. Remove one end of the probe for an instant and reconnect it .There must not be any change.
ii) Reverse the connection and the meter re-shots. If it is so then the electrolytic capacitor working

Sl. No.	Component &Equipment			
	Equipment	**Range**	**Component Name**	**Number**
1	Regulated Power Supply (**RPS)**	(0-30) V	Diode	1N4007
2	Audio Oscillator **(A/O)**	1Hz – 100 KHz	Zener Diode	FZ 9.1
3	Cathode Ray Oscilloscope**(CRO)**	20 MHz	Transistor	BC107
4	Field Effect Transistor Voltmeter**(FETVM)**	(0-1500) V	Field Effect Transistor	BFW19
5	Decade Resistance Box**(DRB)**	1Ω - 100KΩ	Uni Junction Transistor	2N2646
6	Decade Conductance Box **(DCB)**	.001µF - 10µF	SCR	2P4M
7	Decade Inductance Box **(DIB)**	1Mh – 10H	Diac	DB32

Result: Thus we understood to identify the **Equipments and Components** in Electronic Devices Laboratory

Expt.No: 2
Date:

V - I CHARACTERISTICS OF PN JUNCTION DIODE

AIM: To plot the VI characteristics of a PN junction diode in both forward and reverse biased condition
To calculate its cut in voltage, forward resistance and reverse resistance.

APPARATUS REQUIRED –

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	1
2	Diode	1N4007	1
3	DC Ammeters	(0-50) mA, (0-250) μA	1 of each category
4	DC Voltmeter	(0-1) V, (0-30) V	1 of each category
5	Resistor	1KΩ,, 10KΩ,	1 of each category
6	Bread board and Connecting wires		

THEORY:-

A p-n junction diode conducts only in one direction. The V-I characteristics of the diode are curve between voltage across the diode and current through the diode. When external voltage is zero, circuit is open and the potential barrier does not allow the current to flow. Therefore, the circuit current is zero. When P-type (Anode is connected to +ve terminal and n- type (cathode) is connected to –ve terminal of the supply voltage, is known as **forward bias**. The potential barrier is reduced when diode is in the forward biased condition. At some forward voltage, the potential barrier altogether eliminated and current starts flowing through the diode and also in the circuit. The diode is said to be in **ON state**. The current increases with increasing forward voltage. When N-type (cathode) is connected to +ve terminal and P-type (Anode) is connected to the –ve terminal of the supply voltage is known as **reverse bias** and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. The diode is said to be in **OFF state**. The reverse bias current is due to minority charge carriers.

CIRCUIT DIAGRAM:-

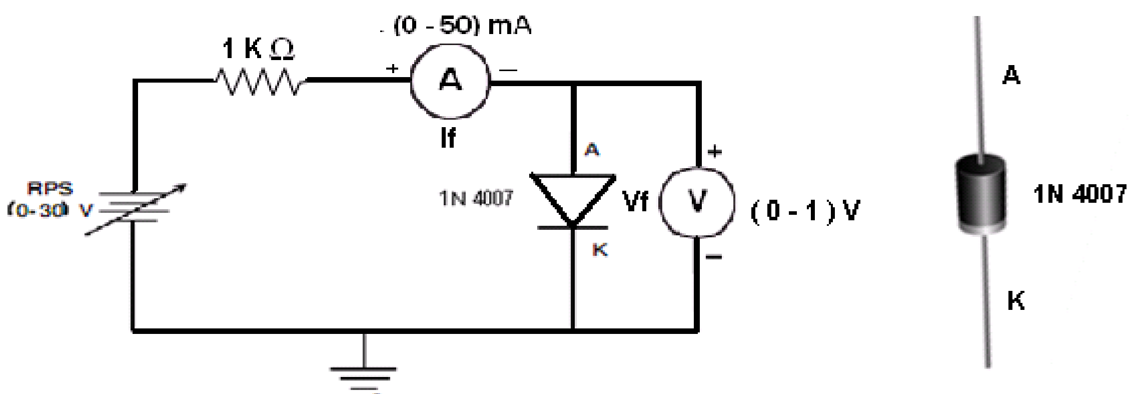


Fig. : V - I Characteristics of Semiconductor Diode (Forward Bias)

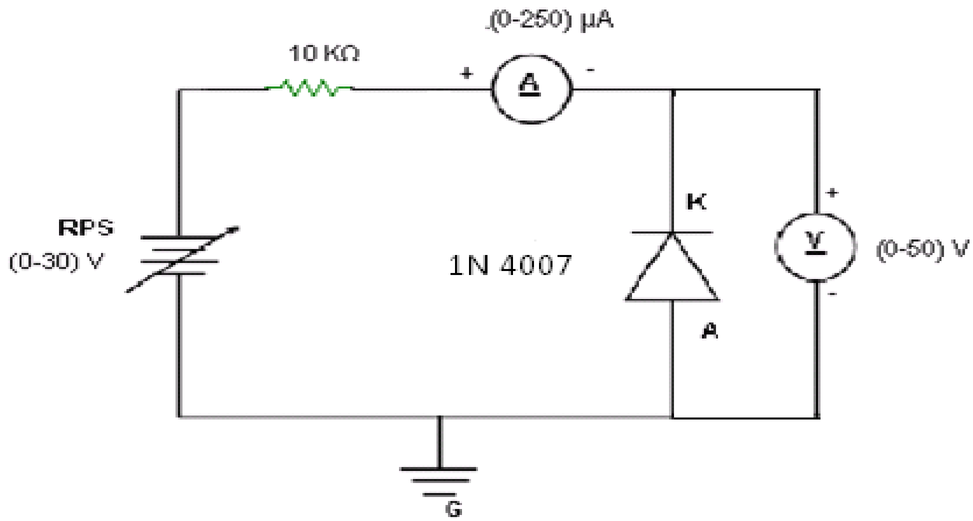
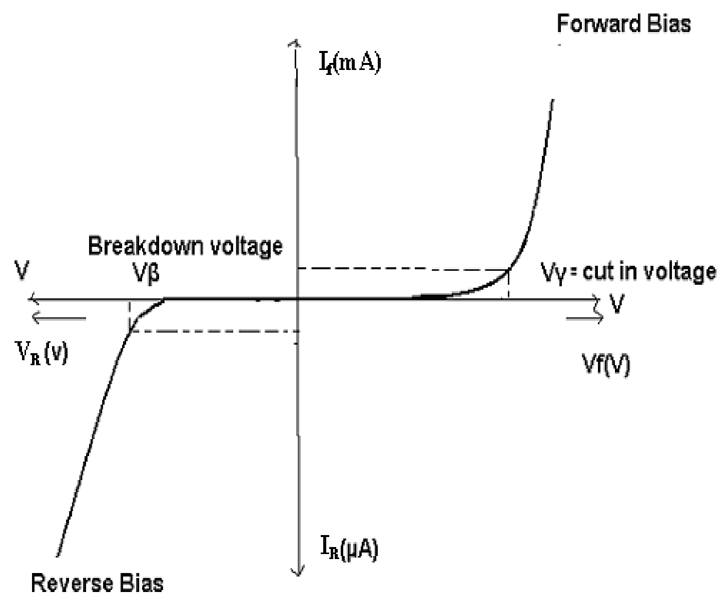


Fig. : V-I Characteristics of Semiconductor Diode (Reverse Bias)

MODEL WAVEFORM:-



PROCEDURE:-

FORWARD BIAS:-

1. Connections are made as per the circuit diagram.
2. For forward bias, the +ve is connected to the anode and –ve is connected to the cathode of the diode.
3. Switch on the power supply and increases the input voltage (supply voltage) in steps.
4. Note down the corresponding current flowing through the diode and voltage across the diode for each and every step of the input voltage.
5. The readings of voltage and current are tabulated and a graph is plotted between voltage and current.

REVERSE BIAS:-

1. Connections are made as per the circuit diagram
2. . For reverse bias, the +ve is connected to the cathode and –ve is connected to the anode of the diode.
3. Switch on the power supply and increase the input voltage (supply voltage) in steps.
4. Note down the corresponding current flowing through the diode voltage across the diode for each and every step of the input voltage.
5. The readings of voltage and current are tabulated and graph is plotted between voltage and current.

OBSERVATION:-

FORWARD BIAS
REVERSE BIAS:-

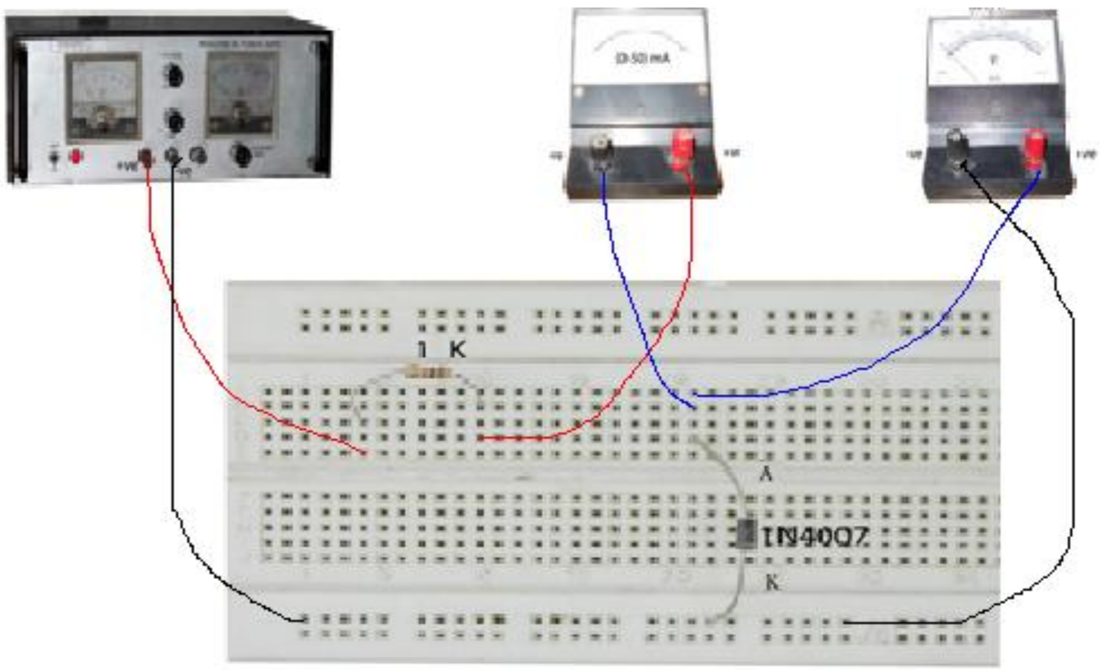
Sl. No.	Forward biasvoltage (V)	Forward bias current (mA)
1	0	0
2	0.1	
3	0.2	
4	0.3	
5	0.4	
6	0.5	
7	0.6	
8	0.62	
9	0.64	
10	0.66	
11	0.68	
12	0.7	
13	0.72	

Sl. No.	Reverse bias Voltage (V)	Reverse bias current (μA)
1	0	0
2		20 (μA)
3		40 (μA)
4		60 (μA)
5		80 (μA)
6		100 (μA)
7		120 (μA)
8		140 (μA)
9		160 (μA)
10		180 (μA)
11		200 (μA)

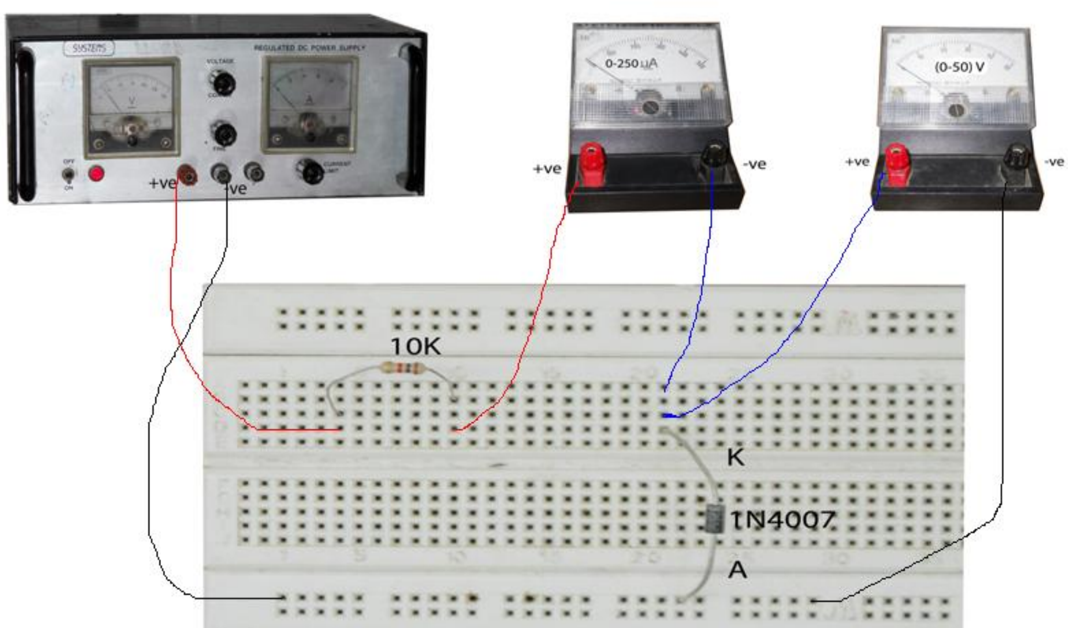
RESULT: The forward and reverse characteristics of the semiconductor diode has been plotted
The forward resistance of the diode = ---------
The cut-in voltage of the diode = ---------

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior

BREAD BOARD CONNECTION



V I CHARACTERISTICS OF PN JUNCTION DIODE (FORWARD BIAS)



V I CHARAICTERISTICS OF PN JUNCTION DIODE (REVERSE BIAS)

Expt.No: 3

Date: **V - I CHARACTERISTICS OF ZENER DIODE**

AIM: - To plot the VI characteristics of a ZENER diode in both forward and reverse biased condition

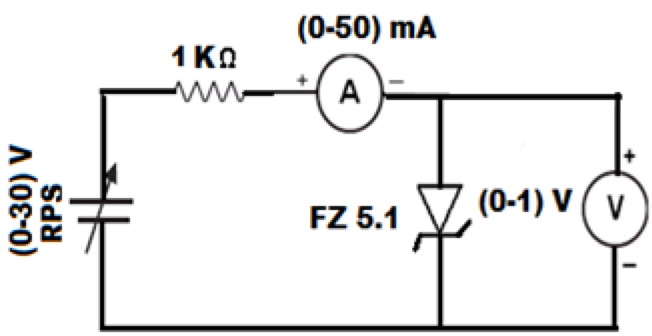
APPARATUS REQUIRED –

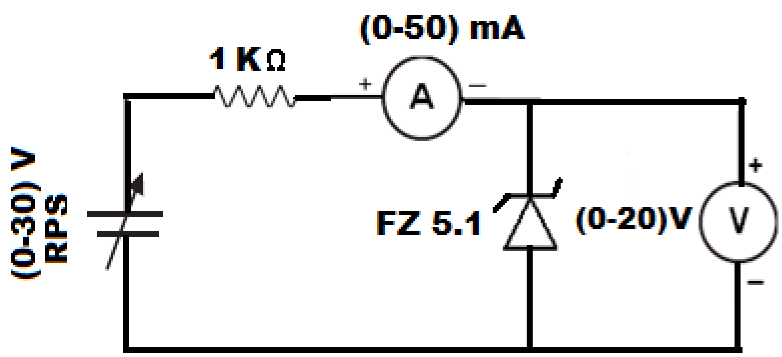
Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	1
2	Zener Diode	FZ 9.1V	1.
3	DC Ammeters	(0-50) mA,	1
4	DC Voltmeter	(0-1) V, (0-20) V	1 of each category
5	Resistor	1KΩ	1
6	Bread board and Connecting wires		

Theory:-

A zener diode is heavily doped p-n junction diode, specially made to operate in the sharp break down voltage. A p-n junction diode normally does not conduct when reverse biased. But a zener diode is always reverse connected i.e it is always reverse-biased. When forward biased, its Characteristics are just those of ordinary diode. In reverse bias, if the reverse bias is increased, at a particular voltage it starts conducting heavily. This voltage is called **Break down Voltage**. The zener diode is not immediately burnt just because it has entered the breakdown region. As long as the external circuit connected to the diode limits the diode current to less than burnt out value, the diode will not burnt out. It is mainly used in **voltage regulators**.

CIRCUIT DIAGRAM:-STATIC CHARACTERISTICS:-

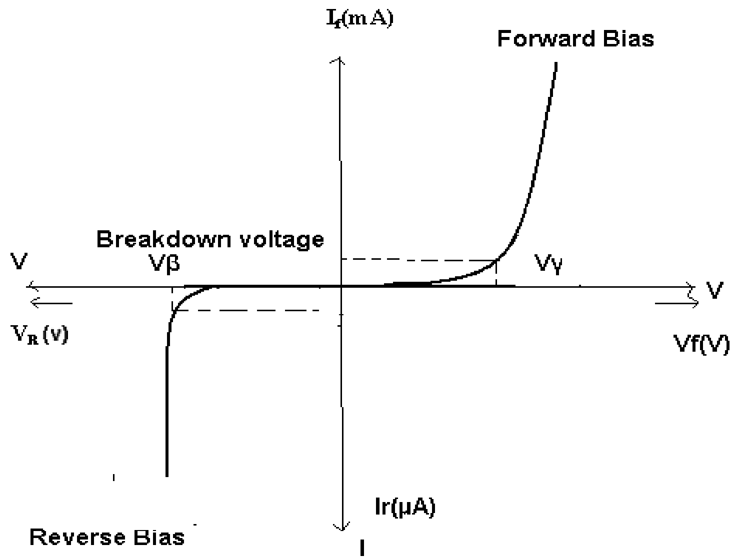




PROCEDURE-

1. Connections are made as per the circuit diagram.
2. The Regulated power supply voltage is increased in steps.
3. The zener current (Iz), and the zener voltage (Vz.) are observed and then noted in the tabular form.
4. A graph is plotted between zener current (Iz) and zener voltage (Vz).
5. Do the above steps for reverse bias connections as shown in the circuit diagrams.

MODEL WAVEFORMS



OBSERVATIONS:-

Forward bias

Sl.No	Forward biasvoltage (V)	Forward bias current (mA)
1	0	
2	0.1	
3	0.2	
4	0.3	
5	0.4	
6	0.5	
7	0.6	
8	0.7	
9	0.72	
10	0.74	
11	0.76	
12	0.78	

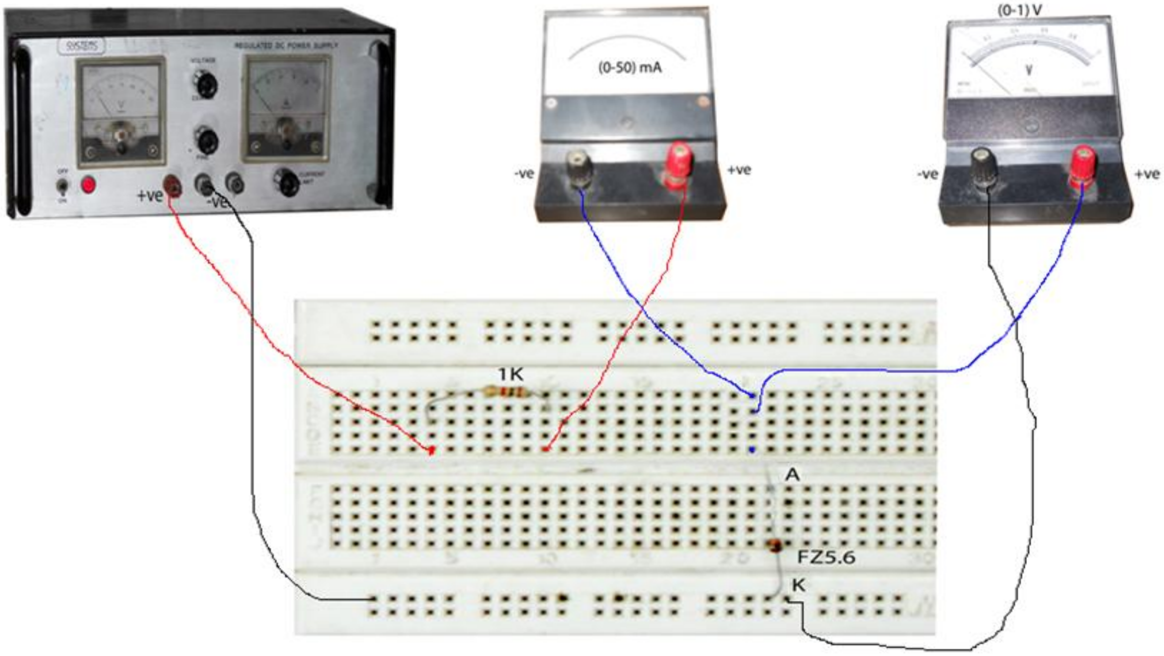
Reverse bias

Sl.No	Reverse biasvoltage (V)	Reverse bias current (mA)
1		0 mA
2		1 mA
3		2 mA
4		3 mA
5		4 mA
6		5 mA
7		6 mA
8		7 mA
9		8 mA
10		9 mA
11		10 mA
12		11 mA
13		12 mA
14		13 mA
15		14 mA
16		15 mA

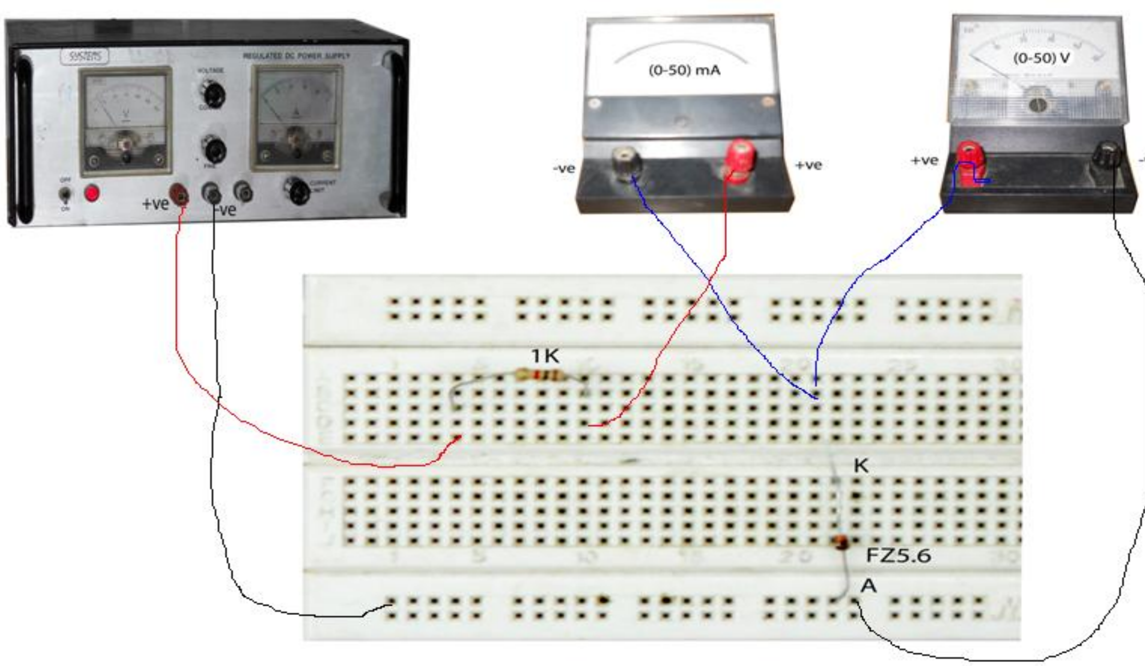
RESULT: The forward and reverse characteristics of the zener diode have been plotted.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

BREAD BOARD CONNECTION



V I CHARACTERISTICS OF ZENER DIODE (FORWARD BIAS)



V I CHARACTERISTICS OF ZENER DIODE (REVERSE BIAS)

Expt.No:4

Date: **CHARACTERISTICS OF TRANSISTOR UNDER COMMONBASE CONFIGURATION**

AIM: To determine the input & output characteristics of the transistor when operated on common base configuration.

APPARATUS REQUIRED:

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	Transistor	BC 107	1
3	DC Ammeters	(0-50) mA	2
4	DC Voltmeter	(0-50) V	1
5	FET Voltmeter	(0-1.5) V DC Mode	1
6	Resistor	1KΩ,5.6 KΩ	Each one
7	Bread board and Connecting wires		

THEORY:

The terminology used for denoting the three basic transistor configurations indicates the transistor terminal that is common to both input and output circuits. This gives rise to the three terms: common base, common collector and common emitter. The term grounded, i.e. grounded base, grounded collector and grounded emitter may also be used on occasions because the common element signal is normally grounded. In CB configuration, the base is common to both input (emitter) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased. This transistor configuration provides low input impedance while offering high output impedance. Although the voltage is high, the current gain is low and the overall power gain is also low when compared to the other transistor configurations. The other salient feature of this configuration is that the input and output are in phase.

CIRCUIT DIAGRAM:

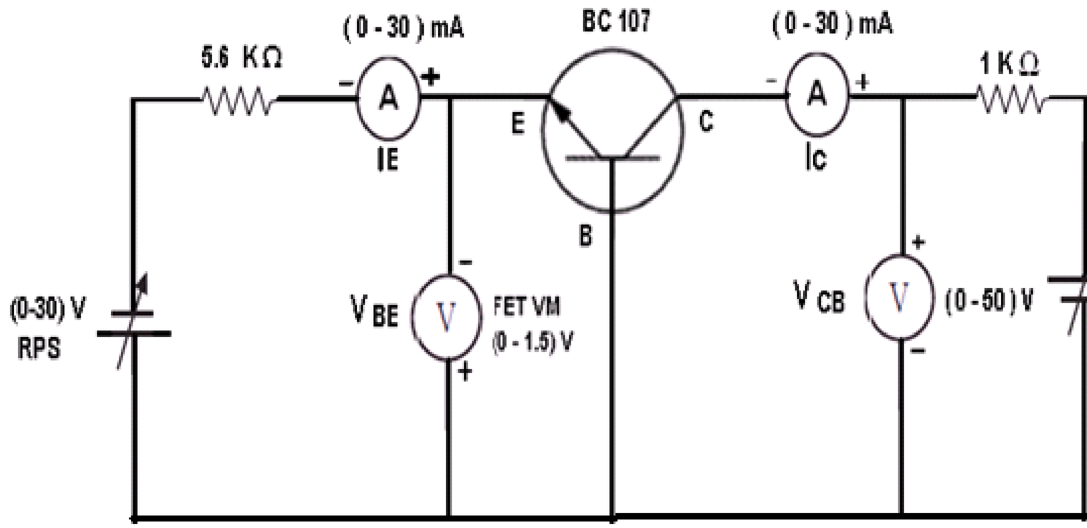
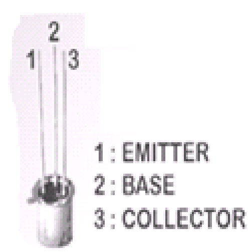


Fig. : Common Base Configuration



PROCEDURE:

INPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the input characteristics, the output voltage VCB is kept constant at 0V and fordifferent values of VEB and IE are noted down.
3. Repeat the above step keeping VCB at 2V, 4V, and 6V.All the readings are tabulated.
4. A graph is drawn between VEB and IE for constant VCB.

OUTPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the output characteristics, the input IE is kept constant at 1m A and for different values of VCB, note down the values of IC.
3. Repeat the above step for the values of IE at 2 mA, 3 mA, and 4 mA, all the readingsare tabulated.
4. A graph is drawn between VCB and Ic for constant IE

OBSERVATIONS:

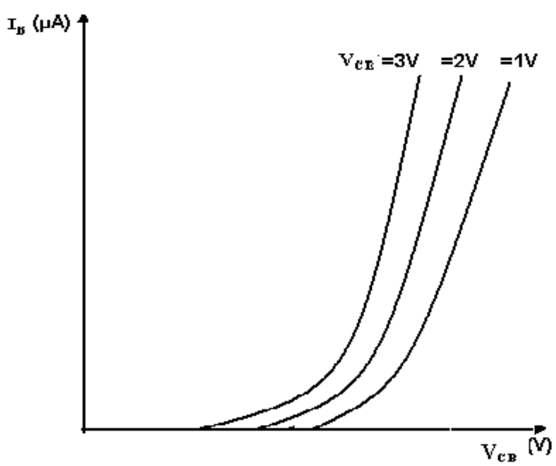
INPUT CHARACTERISTICS: OUTPUT CHARACTERISTICS:

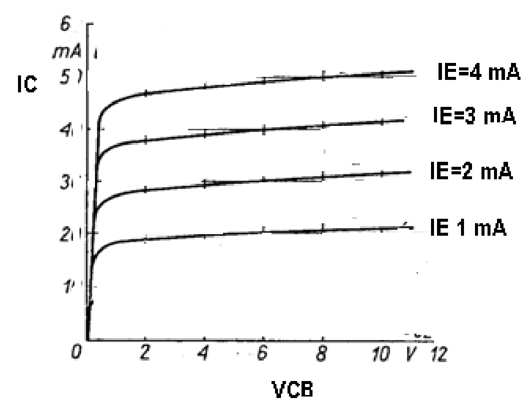
S.No	V_{CB}=0V		V_{CB}=1V	
	V_{EB} (V)	I_E (mA)	V_{EB} (V)	I_E (mA)
1		0 mA		0 mA
2		0.5 mA		0.5 mA
3		1 mA		1 mA
4		1.5 mA		1.5 mA
5		2 mA		2 mA
6		2.5 mA		2.5 mA
7		3 mA		3 mA

S.No	I_E = 1 mA		I_E = 2 mA	
	V_{CB} (V)	I_C (mA)	V_{CB} (V)	I_C (mA)
1	0 V		0 V	
2	1 V		1 V	
3	2 V		2 V	
•	•		•	
•	•		•	
10	9 V		9 V	
11	10 V		10 V	

MODEL GRAPHS:

INPUT CHARACTERISTICSOUTPUT CHARACTERISTICS

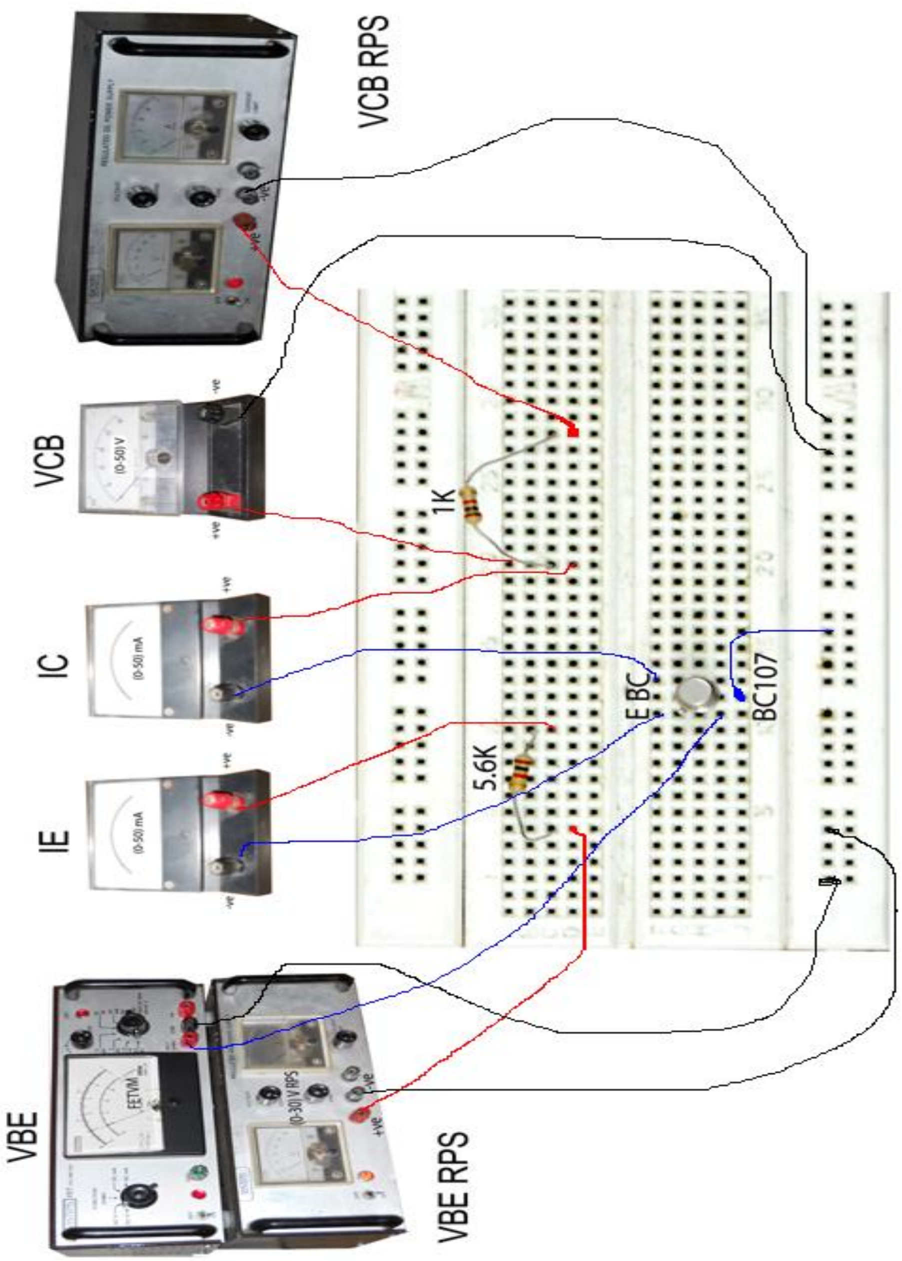




RESULT: The input and output characteristics of transistor under common base configuration has been plotted.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

BREAD BOARD CONNECTION



CHARACTERISTICS OF TRANSISTOR UNDER COMMON BASE CONFIGURATION

Expt.No:5

Date: **CHARACTERISTICS OF TRANSISTOR UNDER COMMON EMITTER CONFIGURATION**

AIM: To determine the input & output characteristics of the transistor when operated on common emitter configuration.

APPARATUSREQUIRED :

Sl. No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	Transistor	BC 107	1
3	DC Ammeters	(0-50) mA, (0-250) μA	1 of each category
4	DC Voltmeter	(0-50) V	1
5	FET Voltmeter	(0-1.5) V	1
6	Resistor	1KΩ, 100KΩ	Each one
7	Bread board and Connecting wires		

THEORY:

A transistor is a three terminal device. The terminals are emitter, base, collector. In common emitter configuration, input voltage is applied between base and emitter terminals and output is taken across the collector and emitter terminals. Therefore the emitter terminal is common to both input and output. The input characteristics resemble that of a forward biased diode curve. This is expected since the Base-Emitter junction of the transistor is forward biased. As compared to CB arrangement IB increases less rapidly with VBE . Therefore input resistance of CE circuit is higher than that of CB circuit. The output characteristics are drawn between Ic and VCE at constant IB. the collector current varies with VCE unto few volts only. After this the collector current becomes almost constant, and independent of VCE. The value of VCE up to which the collector current changes with V CE is known as Knee voltage. The transistor always operated in the region above Knee voltage, IC is always constant and is approximately equal to IB.The current amplification factor of CE configuration is given by $\beta = \Delta IC/\Delta IB$

CIRCUIT DIAGRAM:

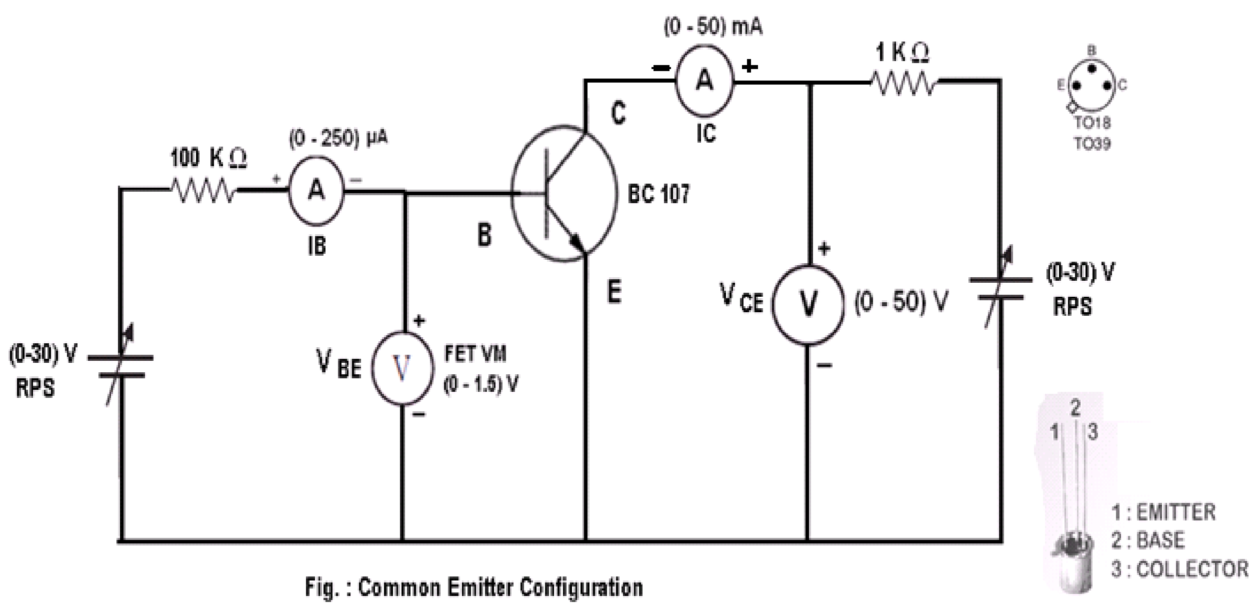


Fig. : Common Emitter Configuration

PROCEDURE:

INPUT CHARECTERSTICS:

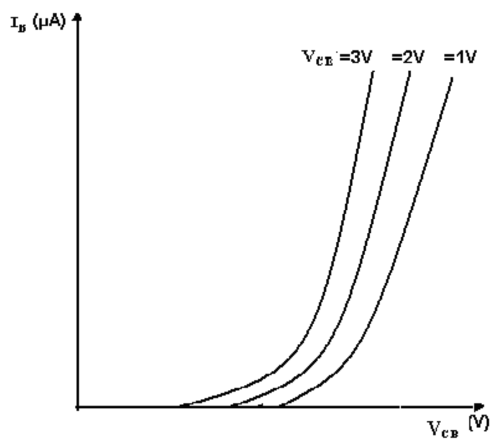
1. Connect the circuit as per the circuit diagram.
2. For plotting the input characteristics the output voltage VCE is kept constant at 0V and for different values of VBE and IB are noted down.
3. Repeat the above step by keeping VCE at 2V and 4V.
4. Tabulate all the readings.
5. Plot the graph between VBE and IB for constant VCE

OUTPUT CHARACTERSTICS:

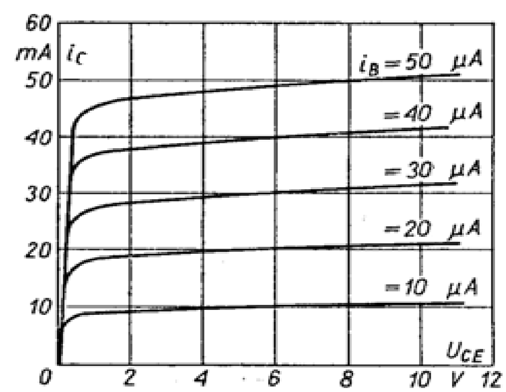
1. Connect the circuit as per the circuit diagram
2. For plotting the output characteristics the input current IB is kept constant at 10μA and for different values of VCE and IC are noted down.
3. Repeat the above step by keeping IB at 30μAand 30 μA.
4. Tabulate the all the readings
5. Plot the graph between VCE and IC for constant IB

MODEL GRAPHS:

INPUT CHARACTERISTICS



OUTPUT CHARACTERISTICS



OBSERVATIONS:

INPUT CHARACTERISTICS

S.No	VCE=0V		VCE=1V	
	VBE(V)	IB (μA)	VEB(V)	IB (μA)
1	0	0 μA	0	0 μA
2		25 μA		25 μA
3		50 μA		50 μA
4		75 μA		75 μA
5		100 μA		100 μA
6		125μA		125μA
7		150 μA		150 μA
8		175μA		175μA
9		200 μA		200 μA
10		225μA		225μA
11		250 μA		250 μA

OUTPUT CHARACTERISTICS

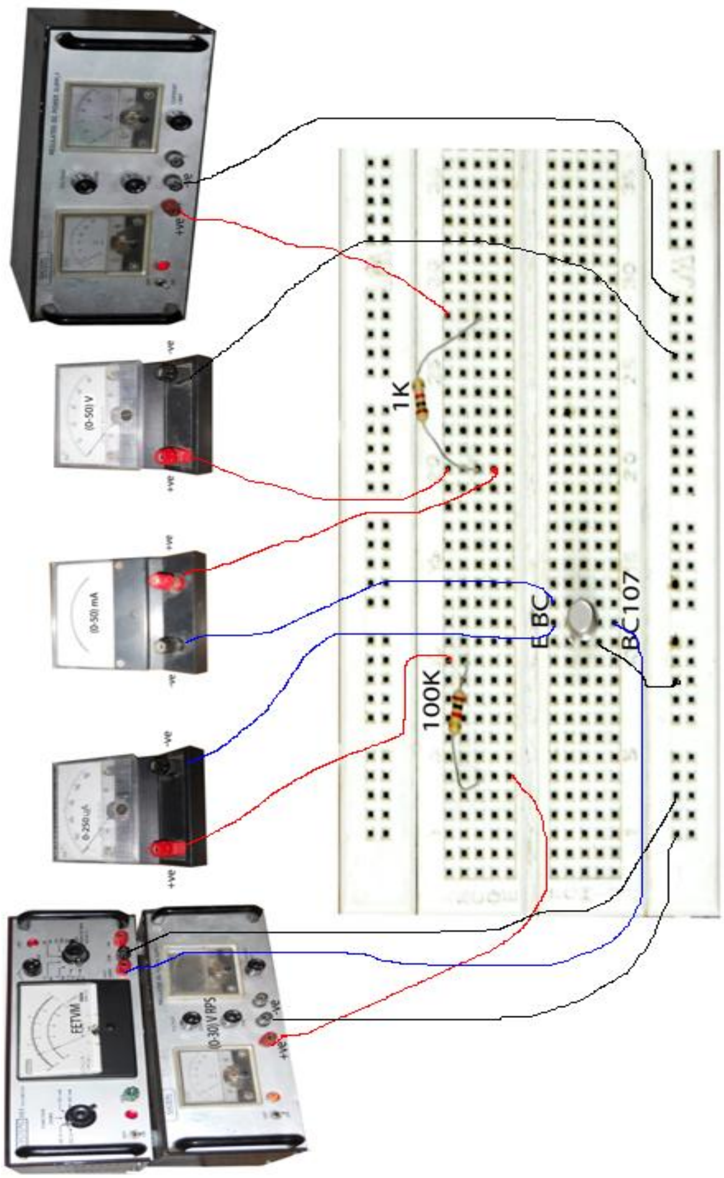
S.No	IB = 10μA		IB = 20 μA	
	VCE(V)	IC(mA)	VCE(V)	IC(mA)
1	0 V	0	0 V	0
2	2 V		2 V	
3	3 V		3 V	
4	4 V		4 V	
5	5 V		5 V	
6	6 V		6 V	
7	7 V		7 V	
8	8 V		8 V	
9	9 V		9 V	
10	10 V		10 V	
11	11 V		11 V	

RESULT: The input and output characteristics of transistor under common emitter configuration has been plotted.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: Why CE Configuration produces 180^{0}Phase shift, did you observed this in the result.

BREAD BOARD CONNECTION



CHARACTERISTICS OF TRANSISTOR UNDER COMMON EMITTER CONFIGURATION

Expt.No:6

Date:**STUDY THE CHARACTERISTICS OF TRANSISTOR UNDER COMMON COLLECTOR CONFIGURATION**

AIM: To determine the input & output characteristics of the transistor when operated on common collector Configuration.

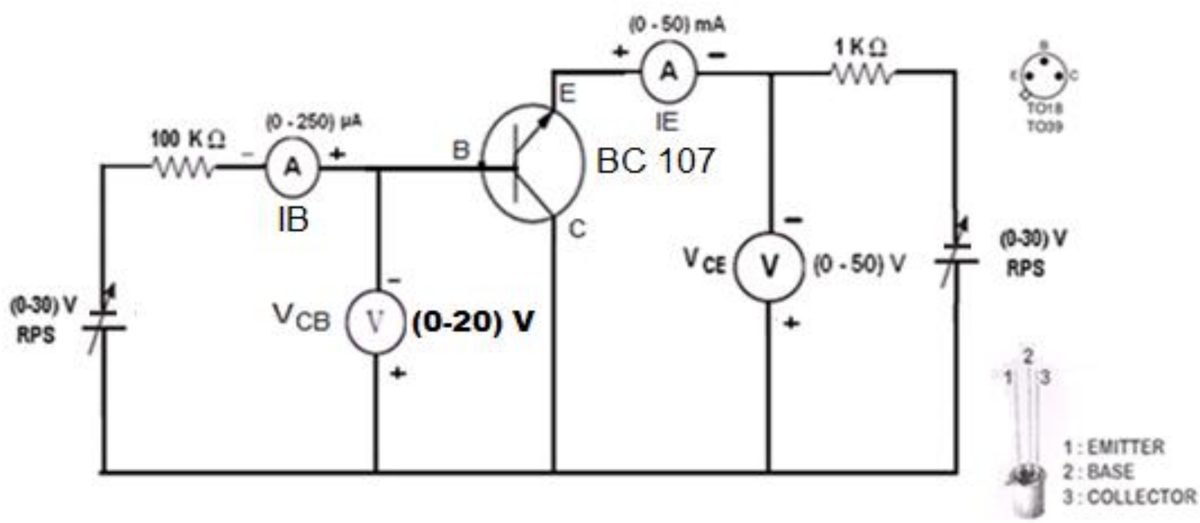
APPARATUS REQUIRED:

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	Transistor	BC 107	1
3	DC Ammeters	(0-50) mA, (0-250) μA	1 of each category
4	DC Voltmeter	(0-50) V	1
5	FET Voltmeter	(0-1.5) V	1
6	Resistor	1KΩ, 100KΩ,	Each one
7	Bread board and Connecting wires		

THEORY:

In the common-collector configuration, also known as the emitter-follower configuration, the collector terminal is common to both the input and the output sections. The configuration is similar to the common-emitter configuration with the output taken from the emitter terminal rather than the collector terminal. CC configuration offers high input impedance and low output impedance and hence it is used for impedance matching applications, that is, for driving low-impedance load from a high-impedance source. The voltage gain offered by CC configuration is less than unity and the value of the current gain is high. The output characteristics of the CC configuration relate the emitter current (IE) to the emitter-collector voltage (VEC) for different values of base current (IB). The characteristics are similar to that for the CE configuration.

CIRCUIT DIAGRAM:



PROCEDURE:

INPUT CHARECTERSTICS:

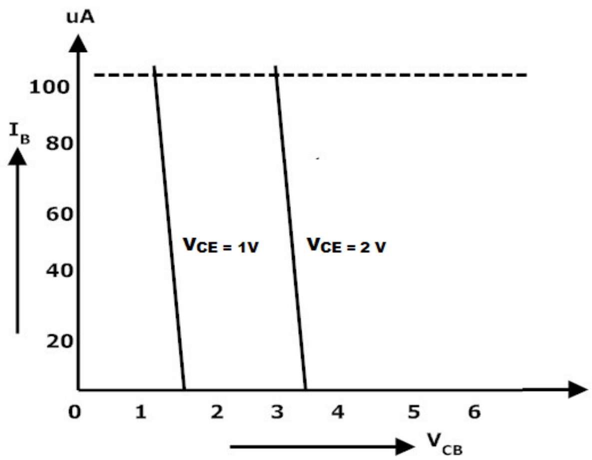
1. Connect the circuit as per the circuit diagram.
2. For plotting the input characteristics the output voltage VCE is kept constant at 0 V and for different values of VCB and IB are noted down.
3. Repeat the above step by keeping VCE at 1V and 5V.
4. Tabulate all the readings.
5. Plot the graph between VBE and IB for constant VCE

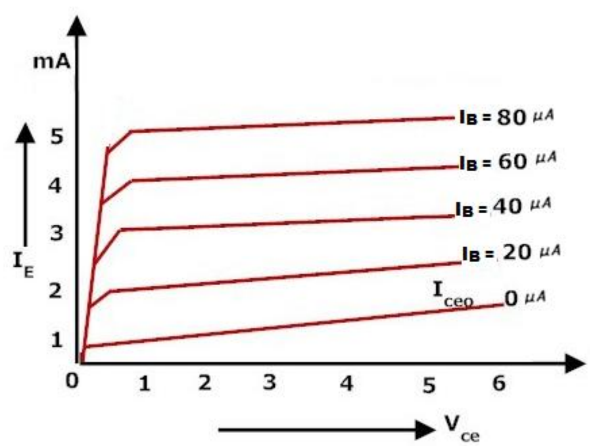
OUTPUT CHARACTERSTICS:

1. Connect the circuit as per the circuit diagram
2. For plotting the output characteristics the input current IB is kept constant at 10μA and for different values of VCE and IE are noted down.
3. Repeat the above step by keeping IB at 30μAand 30 μA.
4. Tabulate the all the readings
5. Plot the graph between VCE and IE for constant IB

MODEL GRAPHS:

INPUT CHARACTERISTICSOUTPUT CHARACTERISTICS





OBSERVATIONS:

INPUT CHARACTERISTICS

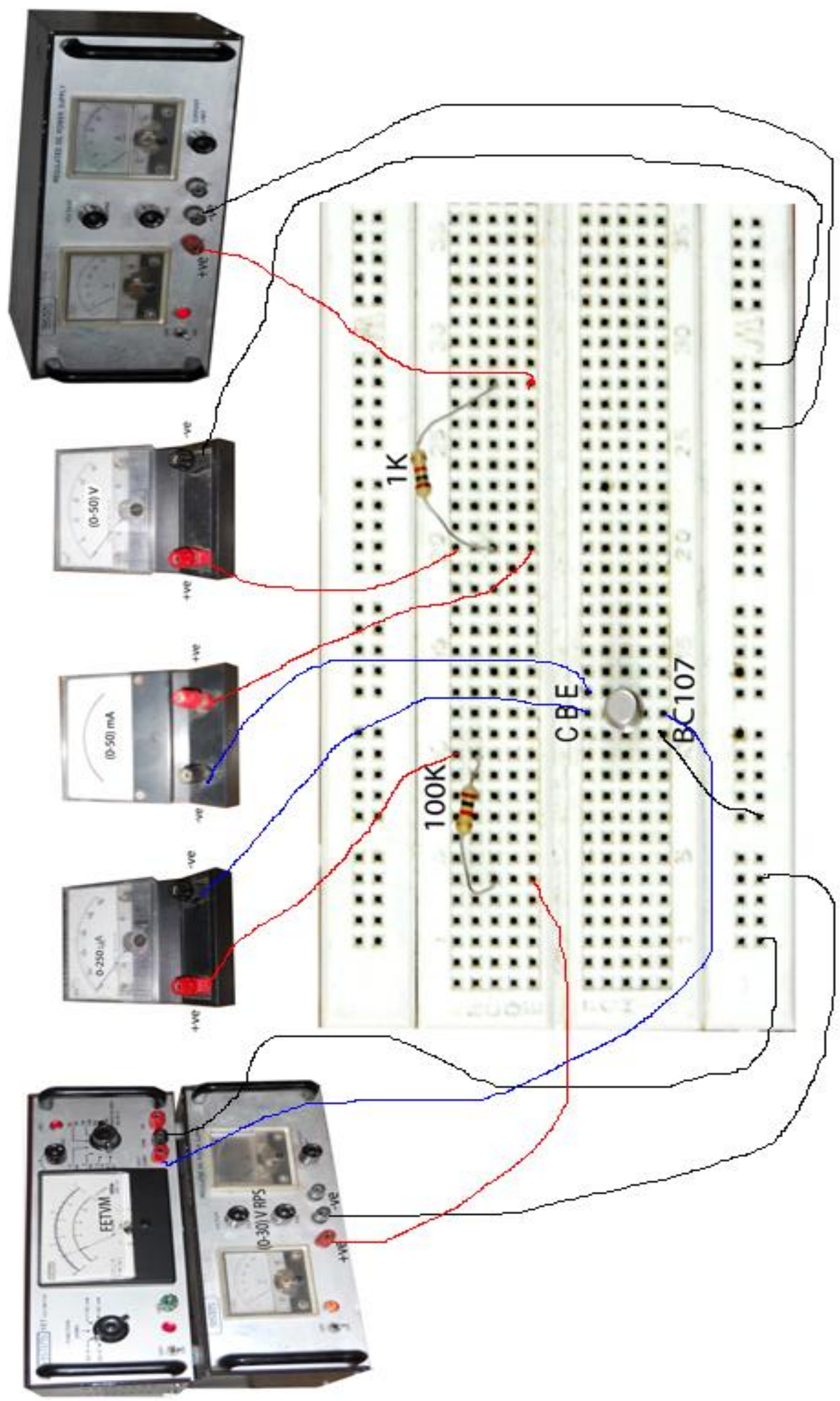
S.No	VCE=1V		VCE=2V	
	VBC(V)	IB (μA)	VBC(V)	IB (μA)

OUTPUT CHARECTERSTICS

S.No	IB = 20μA		IB = 40 μA	
	VCE(V)	IE(mA)	VCE(V)	IE(mA)

RESULT: The input and output characteristics of transistor under common collector configuration has been plotted.

BREAD BOARD CONNECTION



CHARACTERISTICS OF TRANSISTOR UNDER COMMON COLLECTOR CONFIGURATION

Expt.No:7
Date:

CHARACTERISTICS OF JFET

AIM: To obtain the drain and transfer characteristics of JFET.

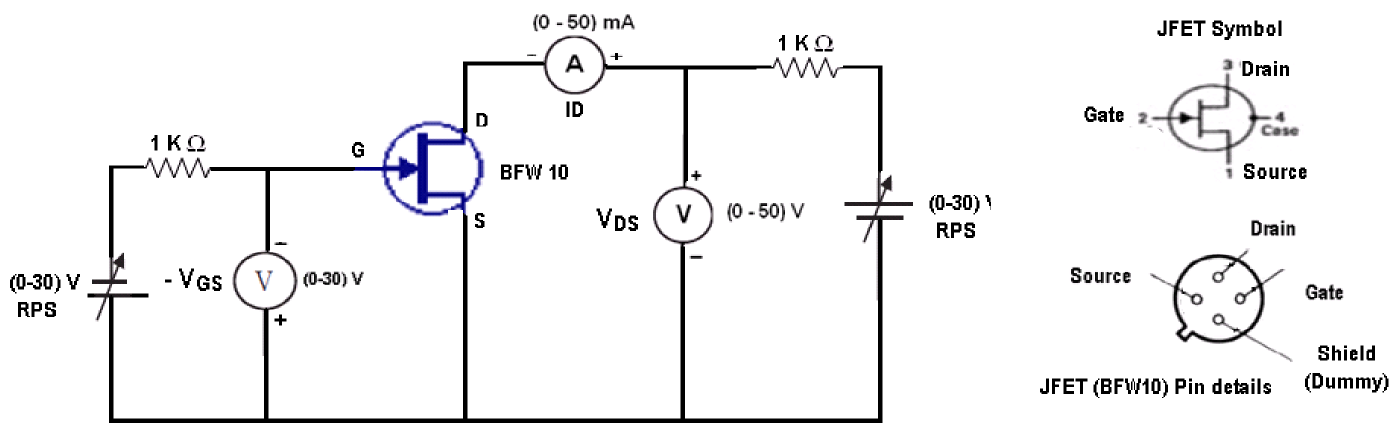
APPARATUS REQUIRED –

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	FET	BFW 10	1
3	DC Ammeters	(0-50) mA	1
4	DC Voltmeter	(0-50) V	2
5	Resistor	1KΩ	2
6	Bread board and Connecting wires		

THEORY:

In the FET, current flows along a semiconductor path called the channel. At one end of the channel, there is an electrode called the **Source**. At the other end of the channel, there is an electrode called the **Drain**. The physical diameter of the channel is fixed, but its effective electrical diameter can be varied by the application of a voltage to a control electrode called the ***Gate***. Field-effect transistors exist in two major classifications. These are known as the **Junction Field Effect Transistor (JFET)** *and the* ***M*****etal-Oxide-Semiconductor Field Effect Transistor (MOSFET).** The junction FET has a channel consisting of N-type semiconductor (N-channel) or P-type semiconductor (P-channel) material; the gate is made of the opposite semiconductor type. In P-type material, electric charges are carried mainly in the form of electron deficiencies called holes. In N-type material, the charge carriers are primarily electrons. In a JFET, the junction is the boundary between the channel and the gate. Normally, this P-N junction is reverse-biased (a DC voltage is applied to it) so that no current flows between the channel and the gate. However, under some conditions there is a small current through the junction during part of the input signal cycle. The FET has some advantages and some disadvantages relative to the bipolar transistor. Consider an n channel device. The gate (p material) is diffused. At zero gate voltage there is no reverse voltage at the channel. So as Vds (drain source voltage) increases, current Ids also increases linearly. As the voltage is increased, at a particular voltage, **pinch off** occurs .This voltage is known as pinch off voltage. After pinch off drain current remains stationary .If we apply a gate voltage (negative voltage) the pinch off occurs early.

CIRCUIT DIAGRAM:

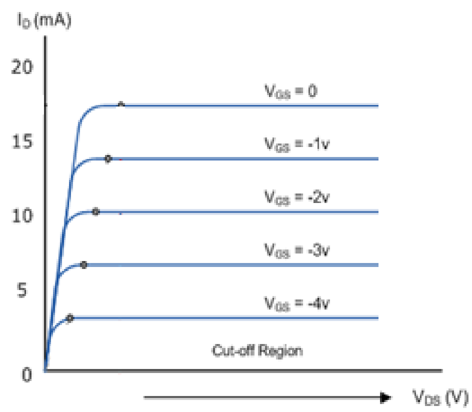


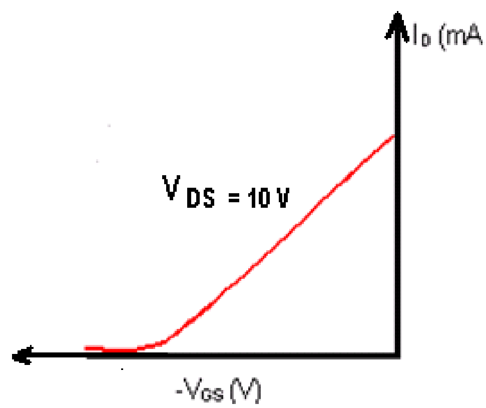
PROCEDURE:

1. Connect the circuit as per the circuit diagram.
2. Keeping VGS as 0V, vary VDS in steps of 0.1V from 0 to 1 V and in steps of 2V from 1 to15V.
3. Note down the drain current Id for each step.
4. Now set VGS to -1V, -2V and -3V and repeat the above steps for each VGS value, record the readings in the table.
5. Keep VDS at 4V and vary VGS in steps of -5V till the drain current Id is 0. Note Id value for each value of VGS.
6. With VDS at 8V repeat the above step and record the readings in the table.
7. Plot the drain and transfer characteristics from tabulated readings.

MODEL GRAPHS:

Drain Characteristics: Transfer Characteristics





OBSERVATIONS

Drain Characteristics:

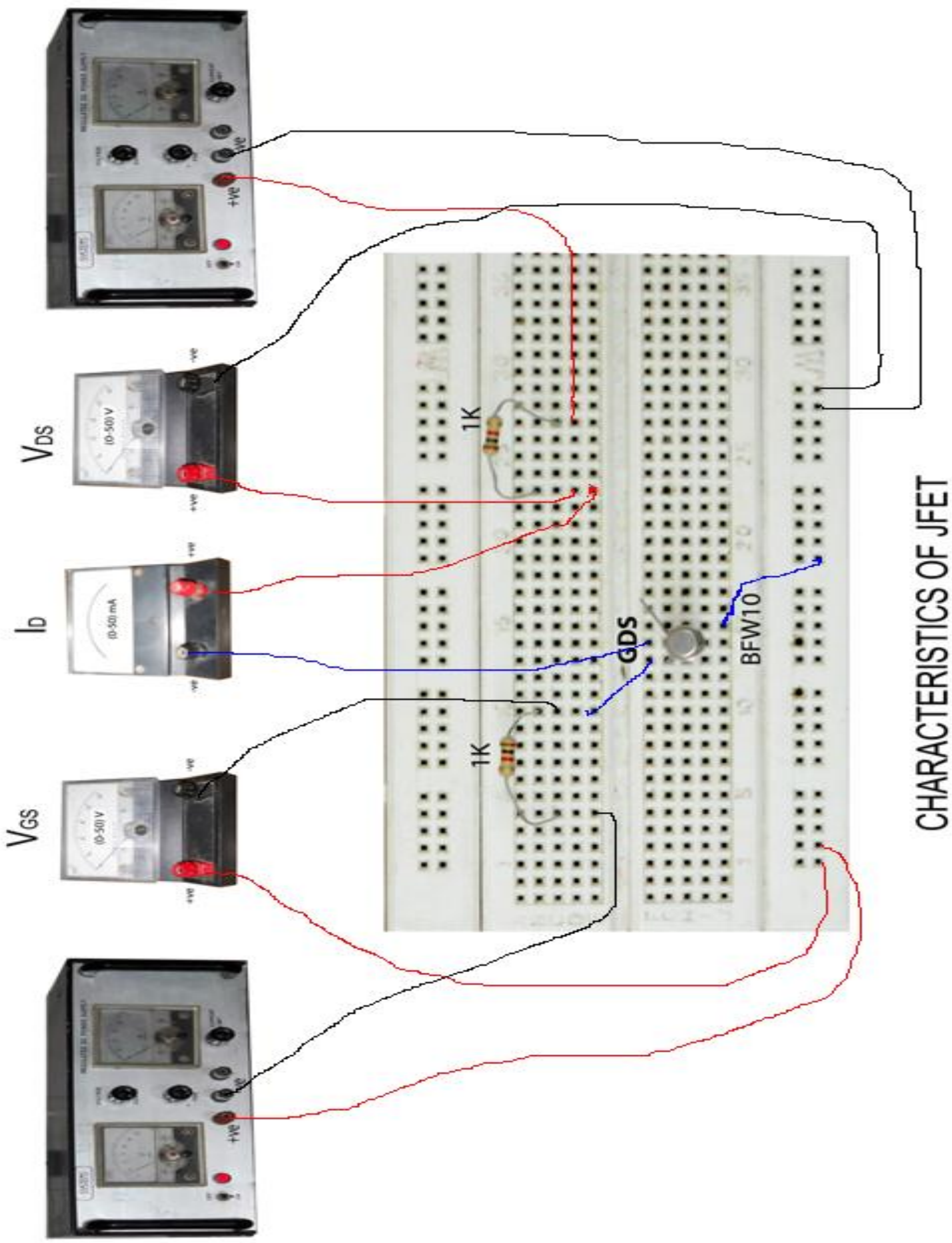
Sl.No	VGS= - 1V		VGS= - 2V	
	VDS(V)	ID(mA)	VDS(V)	ID(mA)
1	0	0	0	0
2	1		1	
3	2		2	
4	3		3	
5	•	•	•	•
6	•	•	•	•
7	13		13	
8	14		14	
9	15		15	

Transfer Characteristics:

Sl.No	VDS = 10 V	
	- VGS(V)	ID(mA)
1	0V	
2	0.5 V	
3	1 V	
4	1.5 V	
5	2 V	
6	2.5 V	
7	3 V	
8	3.5 V	
9	4 V	

RESULT: The drain and transfer characteristics of JFET has been plotted.

BREAD BOARD CONNECTION



Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: Why Vgs is the variable in the above experiment? Student should find the answer and directed to learn the significance of the JFET in electronics.

Expt. No: 8
Date:

CHARACTERISTICS OF UJT

AIM: To determine the emitter characteristics of a UJT

APPARATUS REQUIRED –

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	UJT	2N2646	1
3	DC Ammeters	(0-50) mA	1
4	DC Voltmeter	(0-50) V	2
5	Resistor	560Ω, 1KΩ	Each one
6	Bread board and Connecting wires		

CIRCUIT DIAGRAM

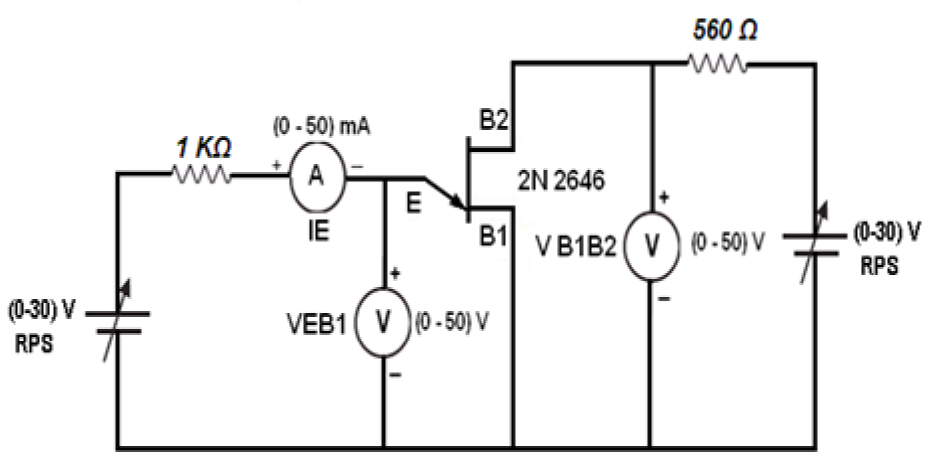
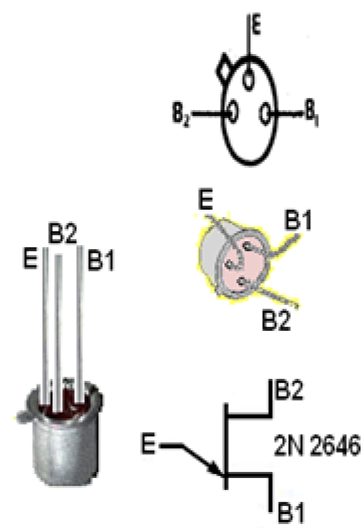


Fig. : V I Characteristics of UJT



Pin details and Component view of UJT

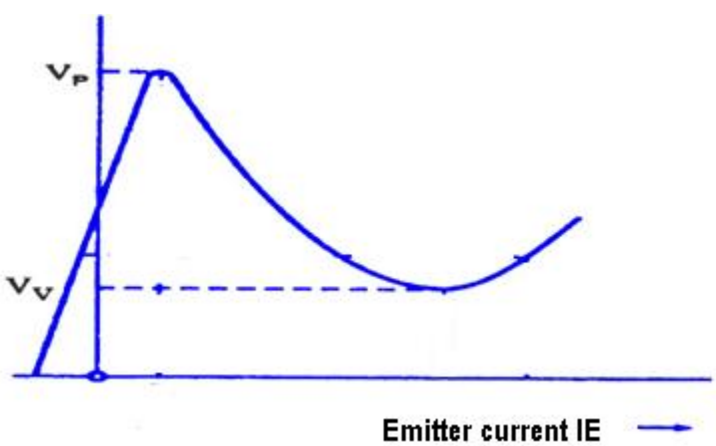
THEORY:

A Unijunction Transistor (UJT) is an electronic semiconductor device that has only one junction. The UJT Unijunction Transistor (UJT) has three terminals emitter (E) and two bases (B1 and B2). The base is formed by lightly doped n-type silicon. Two ohmic contacts B1 and B2 are attached at its ends. The emitter of p-type and it is heavily doped. The resistance between B1 and B2, when the emitter is open-circuit is called inter base resistance. The original unijunction transistor, or UJT, isa simple device that is essentially a bar of N type semiconductor material into which P-type material has been diffused somewhere along its length. The 2N2646 is the most commonly used version of the UJT.The UJT is biased with a positive voltage between the two bases. This causes a potential drop along the length of the device. When the emitter voltage is driven approximately one diode voltage above the voltage at the point where the P diffusion (emitter) is, current will begin to flow from the emitter into the base region. Because the base region is very lightly doped, the additional current (actually charges in the base region) causes (conductivity modulation) which reduces the resistance of the portion of the base between the emitter junction and the B2 terminal. This reduction in resistance means that the emitter junction is more forward biased, and so even more current is injected. Overall, the effect is a negative resistance at the emitter terminal. This is what makes the UJT useful, especially in simple oscillator circuits. When the emitter voltage reaches Vp, the current starts to increase and the emitter voltage starts to decrease. This is represented by negative slope of the characteristics which is referred to as the negative resistance region, beyond the valley point, RB1 reaches minimum value and this region,VEB proportional to IE.

PROCEDURE:

1. Connection is made as per circuit diagram.
2. Output voltage is fixed at a constant level and by varying input voltage corresponding emitter current values are noted down.
3. This procedure is repeated for different values of output voltages.
4. All the readings are tabulated and Intrinsic Stand-Off ratio is calculated usingη = (Vp-VD) / VBB
5. A graph is plotted between VEE and IE for different values of VBE.

MODEL GRAPH:

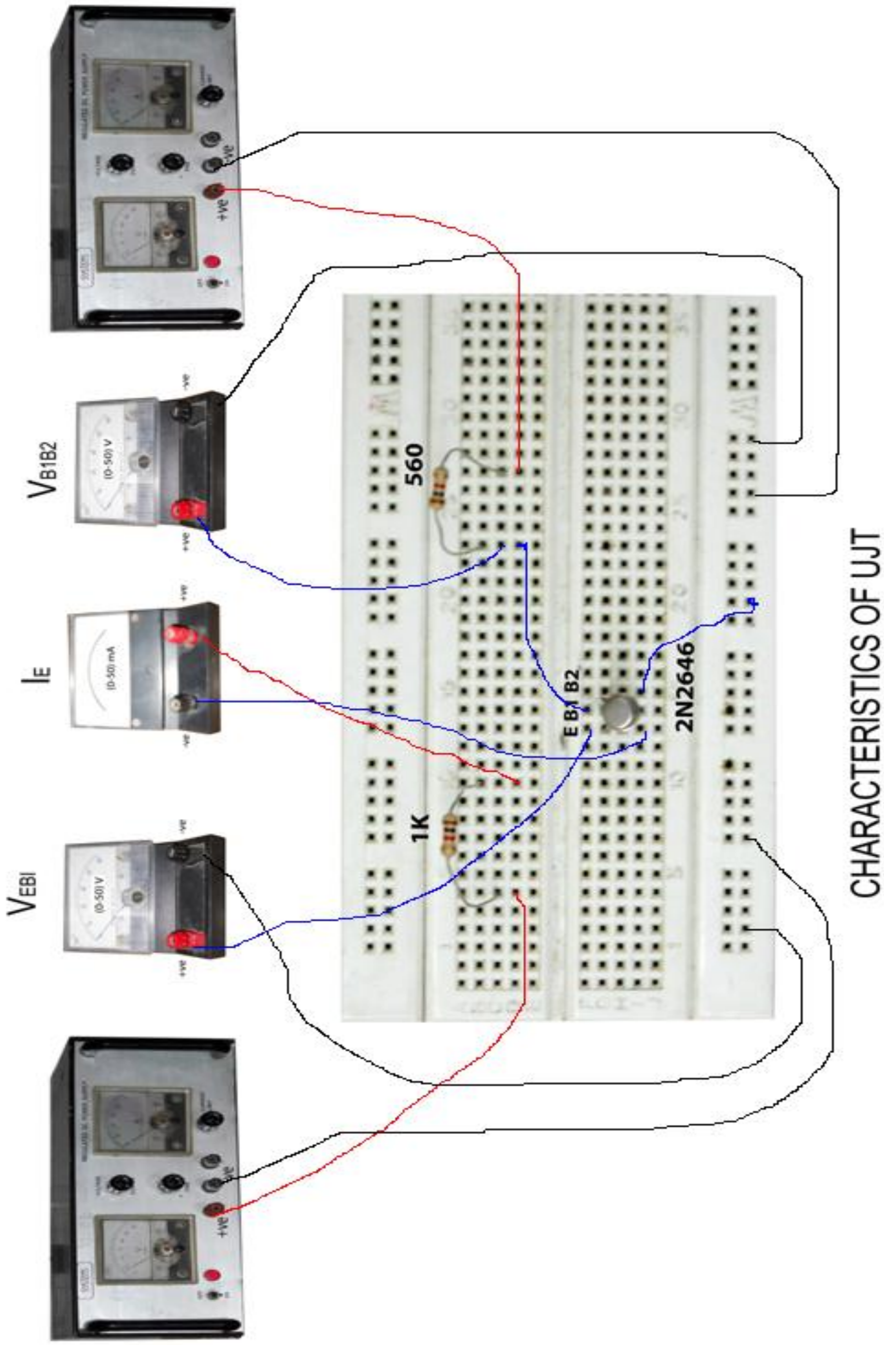


OBSEVATIONS:

S.No	VB1B2 = 3V		VB1B2 = 5V		VB1B2 = 7V	
	VEB1 (V)	IE(mA)	VEB1 (V)	IE(mA)	VEB1 (V)	IE(mA)

RESULT: The emitter characteristic of a UJT has been plotted.

BREAD BOARD CONNECTION



Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior

Expt. No 9

Date: **V - I CHARACTERISTICS OF SILICON-CONTROLLED RECTIFIER (SCR)**

AIM: To plot the VI characteristics of Silicon-Controlled Rectifier (SCR)

APPARATUS REQUIRED

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	2
2	SCR	2P4M	1
3	DC Ammeters	(0-50) mA, (0-50) µA	Each one
4	DC Voltmeter	(0-50) V	1
5	FET Voltmeter	(0-1.5) V	1
6	Resistor	2.2KΩ,56KΩ,	Each one
7	Bread board and Connecting wires		

THEORY:

It is a four layer semiconductor device being alternate of P-type and N-type silicon. It consists os 3 junctions J1, J2, J3 the J1 and J3 operate in forward direction and J2operates in reverse direction and three terminals called anode A, cathode K, and agate G. The operation of SCR can be studied when the gate is open and when the gate is positive with respect to cathode. When gate is open, no voltage is applied at the gate due to reverse bias of the junction J2 no current flows through R2 and hence SCR is at cutt off. When anode voltage is increased J2 tends to breakdown. When the gate positive, with respect to cathode J3 junction is forward biased and J2 is reverse biased .Electrons from N-type material move across junction J3towards gate while holes from P-type material moves across junction J3 towards cathode. So gate current starts flowing, anode current increase is in extremely small current junction J2 break down and SCR conducts heavily. When gate is open thee break over voltage is determined on the minimum forward voltage at which SCR conducts heavily. Now most of the supply voltage appears across the load resistance. The holding current is the maximum anode current gate being open, when break over occurs.

CIRCUIT DIAGRAM:

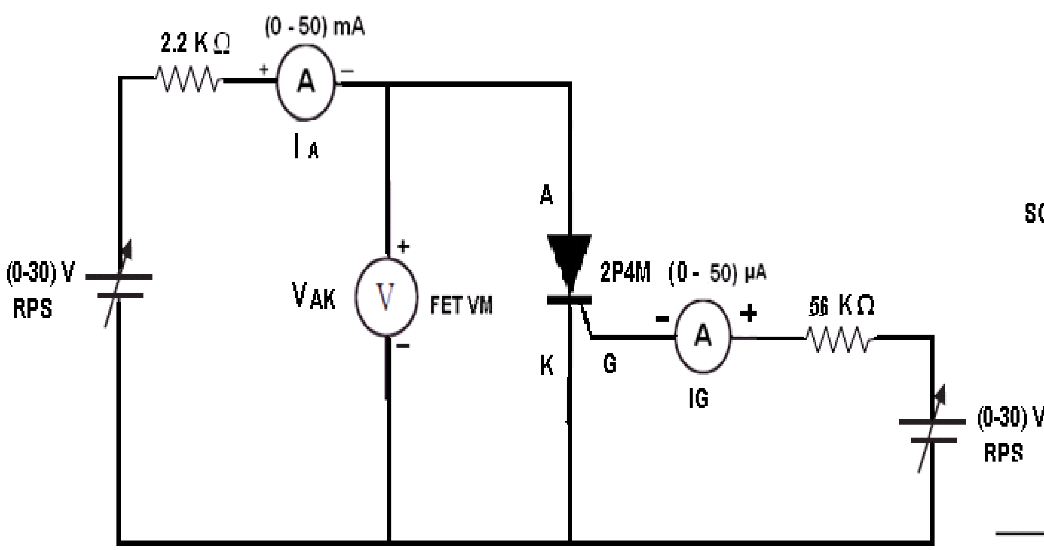
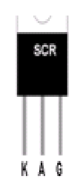
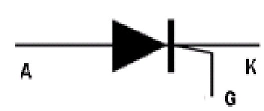


Fig.: V - I Characteristics of Silicon Control Rectifier (SCR)



SCR COMPONENT VIEW



SCR Symbol

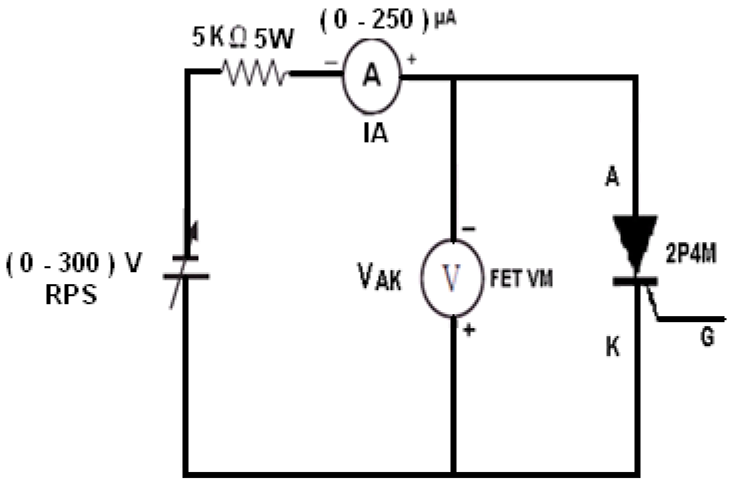
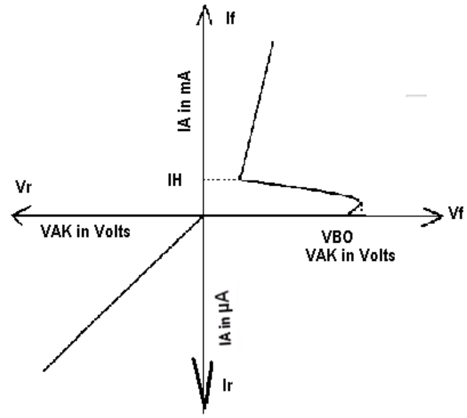


Fig. : V I Characteristics of SCR (Reverse Bias)

MODEL WAVEFORM



PROCEDURE:

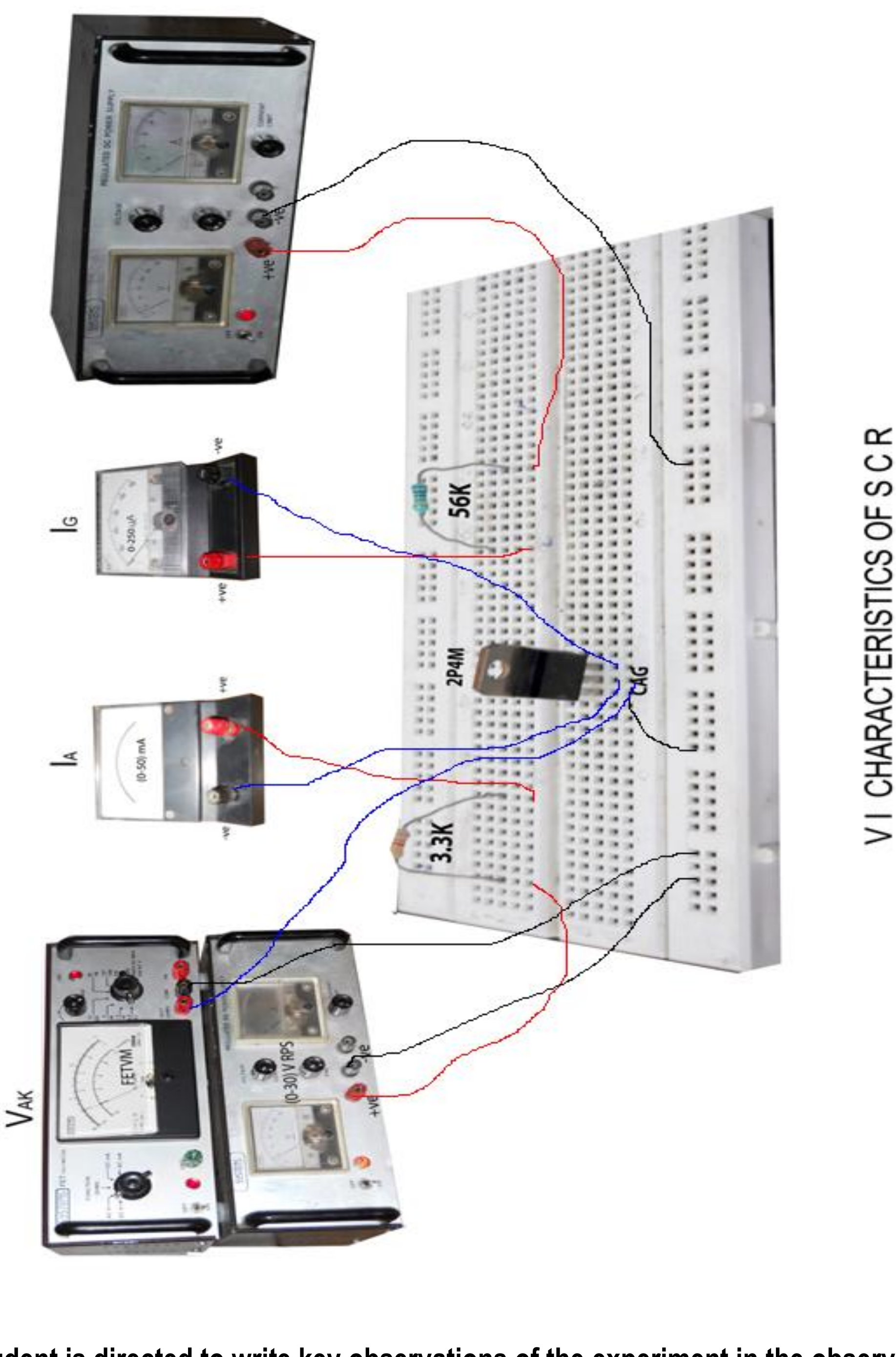
1. Connections are made as per circuit diagram.
2. Adjust the gate supply voltage to keep the Gate Current at some constant value
3. Vary the anode to cathode supply voltage and note down the readings of FET voltmeter and ammeter.
4. A graph is drawn between VAK and IA .

OBSERVATION

Sl.No	Forward Bias		Reverse Bias	
	IG = 10 µA		Gate open	
	VAK in V	IA in mA	VAK in V	IA in µA
1	0	0	0	0
2	2			20 µA
3	4			40 µA
4	6			60 µA
5	8			80 µA
6	10			100 µA
7	0.52			120 µA
8	0.54			140 µA
9	0.56			160 µA
]10	0.58			180 µA
11	0.6			200 µA
12	0.62			220 µA
13	0.64			240 µA
14	0.66			250 µA

RESULT: The VI characteristics of a Silicon-Controlled Rectifier (SCR) have been plotted.

BREAD BOARD CONNECTION



Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: In which way SCR characteristics are different from the other devices?

Expt. No 10
Date:

V - I CHARACTERISTICS OF DIAC

AIM: To plot the VI characteristics of a **DIAC**

APPARATUS REQUIRED:

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-300) V	1
2	DIAC	DB32	1
3	DC Ammeters	(0-50) mA,	1
4	DC Voltmeter	(0-50) V	1
5	Resistor	5KΩ,5W	1
6	Bread board and Connecting wires		

THEORY:

DIAC is a diode that can work on AC. The DIAC has symmetrical breakdown characteristics. The leads are interchangeable. It turns on around 32V. While conducting, it acts like a low resistance with a drop of around 3V. When not conducting, it acts like an open switch.

CIRCUIT DIAGRAM:

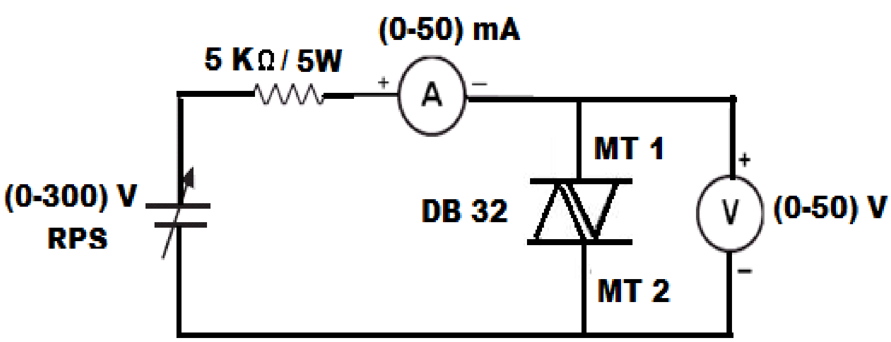
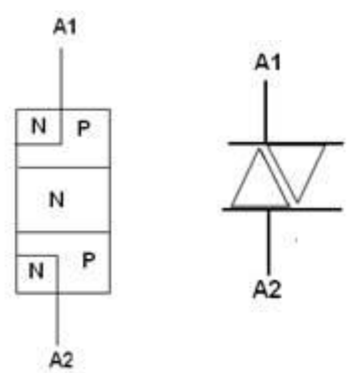


Fig.(a) : FORWARD BIAS



DIAC SYMBOL

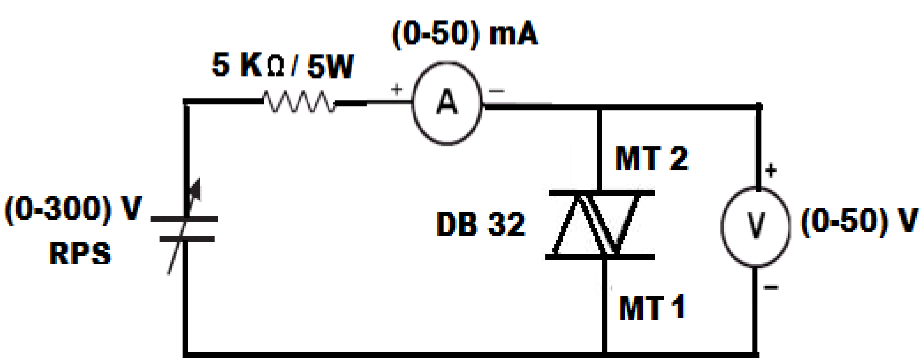
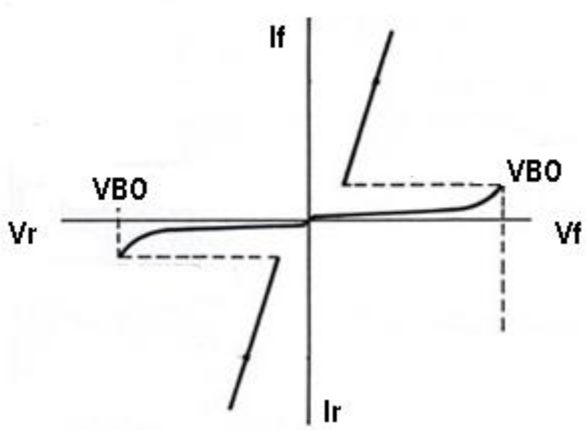


Fig.(b) : REVERSE BIAS

DIAC COMPONENT VIEW

MODEL GRAPH:



PROCEDURE:

1. Connect the circuit as per the circuit diagram.
2. Change the voltage in steps till 32V and observe Voltmeter reading and Ammeter reading. the start of break overvoltage. Observe the conduction of DIAC..
3. Now change the DIAC direction and vary the voltage in steps in the negative direction till -32V and Observe Voltmeter reading and Ammeter reading. The start of break overvoltage. Observe the conduction of DIAC..
4. The characteristics are tabulated and plotted.

OBSERVATIONS:

Reverse Characteristics:

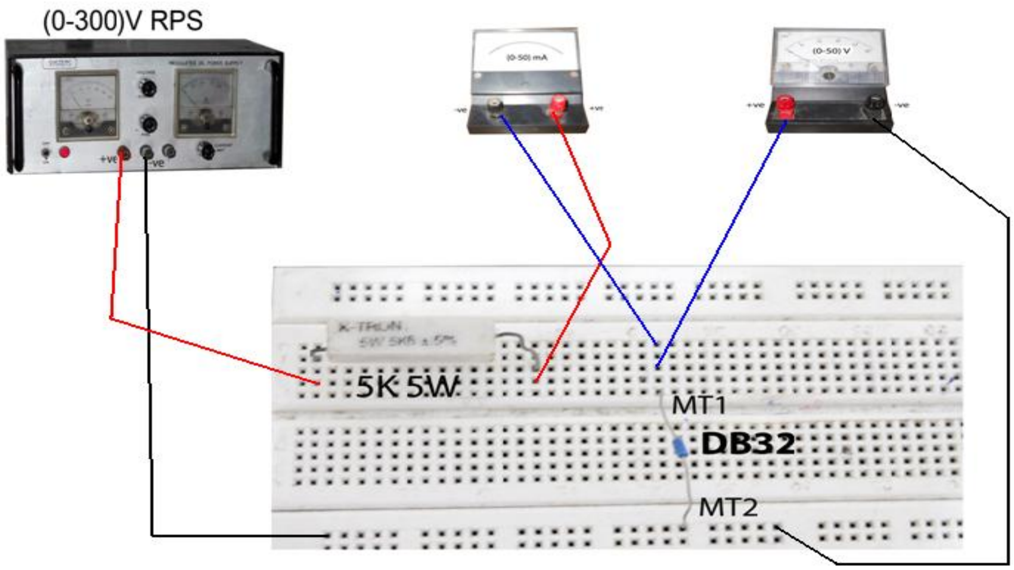
Forward characteristics

Sl.No	Vf (V)	If (mA)
1	0	
2	5	
3	10	
4	15	
5	20	
6	25	
7	30	
8	32	
9		
10		
11		
12		
13		
14		
15		

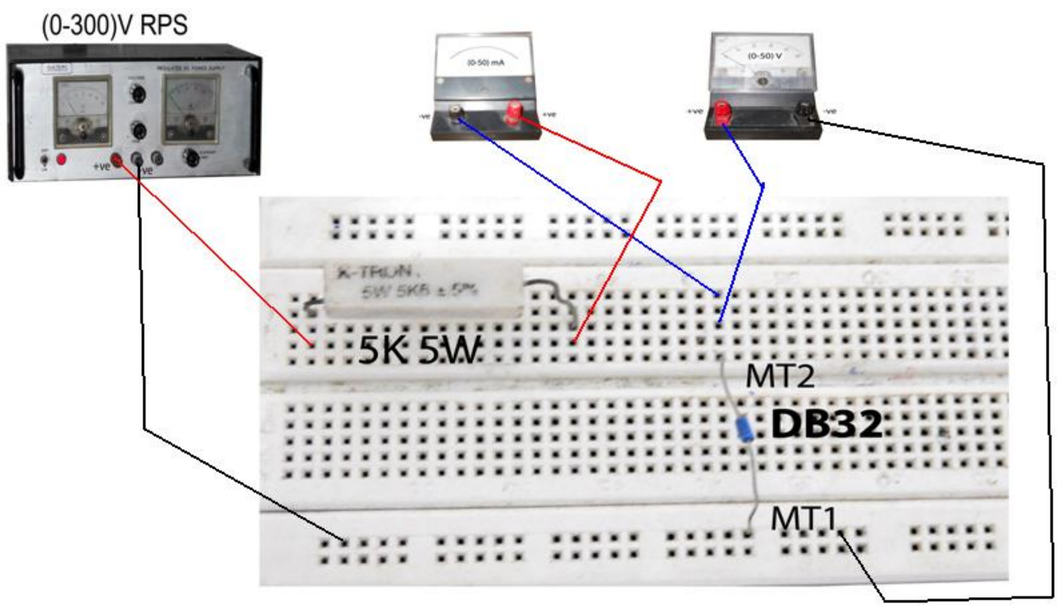
Sl.No	Vr (V)	Ir (mA)
1	0	
2	5	
3	10	
4	15	
5	20	
6	25	
7	30	
8	32	
9		
10		
11		
12		
13		
14		
15		

RESULT: The VI characteristics of a DIAC have been plotted.

BREAD BOARD CONNECTION



CHARACTERISTICS OF DIAC (FORWARD BIAS)



CHARACTERISTICS OF DIAC (REVERSE BIAS)

SAQ: Student directed to compare the FB and RB behavior of SCR, UJT, DIAC and TRIAC and make a tabular column representing the similarities and differences in their behavior.

Expt. No 11

Date: **CHARACTERISTICS OF LIGHT DEPENDENT RESISTOR (LDR)**

AIM: To determine the resistance of LDR when illuminated and covered.

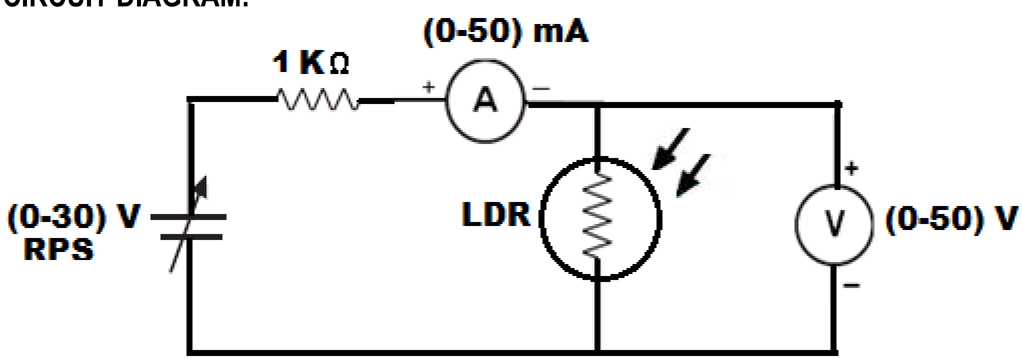
APPARATUS REQUIRED:

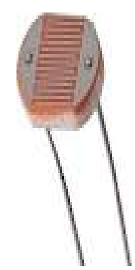
Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	1
2	LDR	------	1
3	DC Ammeters	(0-50) mA,	1
4	DC Voltmeter	(0-50) V	1
5	Resistor	1KΩ	1
6	Bread board and Connecting wires		

THEORY:

Light Dependent Resistor (**LDR**) is made of a thin layer of semiconductor material such as cadmium sulfide or lead sulfide. The semiconductor layer is enclosed in a sealed housing. A glass window in the housing permits light to fall on the active material of the cell. It exhibits the property that its resistance decreases in the presence of light and increases in the absence of light. The LDR simply acts as a conductor whose resistance changes when illuminated.

CIRCUIT DIAGRAM:





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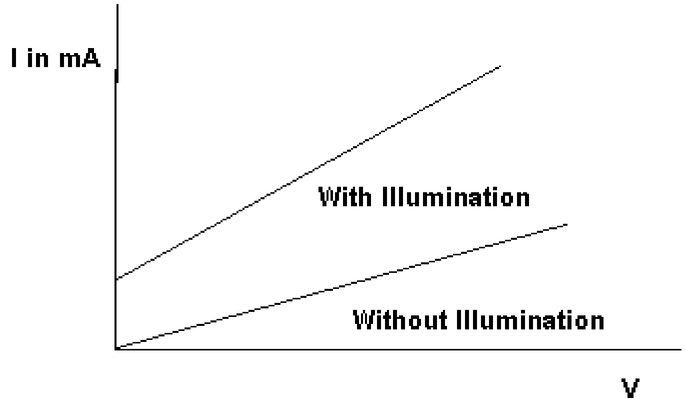
LDR COMPONENT VIEW

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The supply voltage is given.
3. The LDR is covered and voltage and current readings are noted.
4. The voltage applied is further increased and corresponding readings are noted.
5. The experiment is repeated in illuminated conditions and readings are noted.

MODEL GRAPH:



OBSERVATIONS:

WITH LIGHT

Sl.No	Voltage in V	Current in mA
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	

WITH OUT LIGHT

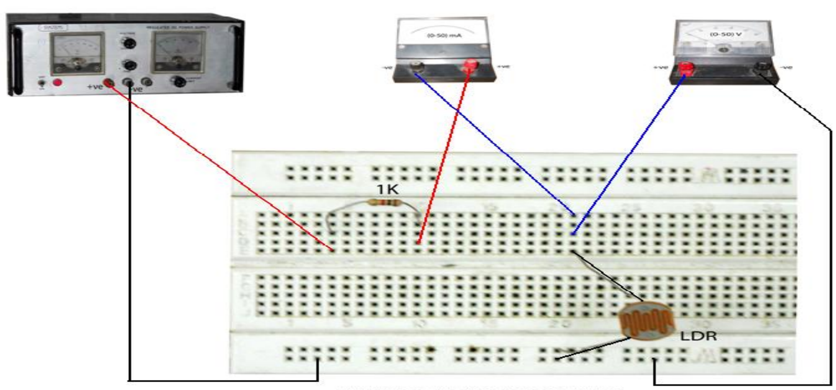
Sl.No	Voltage in V	Current in mA
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	

RESULT: The resistance of LDR when illuminated and covered has been calculated.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

Exercise: List out the applications of LDR and submit an assignment to the lab incharge about any two of them by the next session.

BREAD BOARD CONNECTION



CHARACTERISTICS OF LDR

Expt. No 12

Date

DIODE APPLICATIONS (CLIPPING)

AIM:

To construct circuits to function as Clipper (Positive and Negative) using diodes.

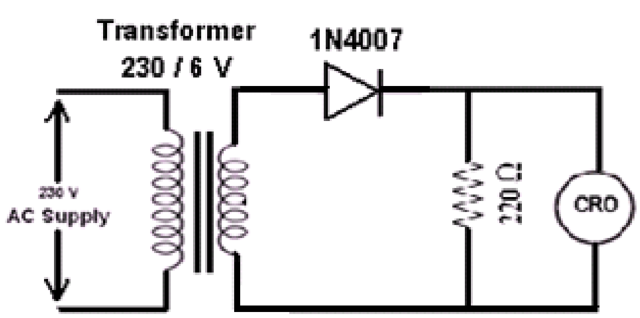
APPARATUS REQUIRED:

Sl.No.	Description	Range / Number/ Value	Qty
1	Diode	1N4007	2
2	Transformer	6-0-6 or 12-0-12	1
3	CRO	20 MHz	1
4	Resistor	$220\Omega, \frac{1}{2}\,W$	1
5	Bread board and Connecting wires		

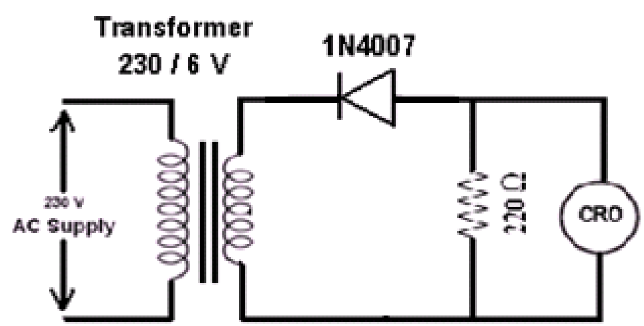
THEORY:

Clipper is a circuit with which a waveform is shaped by removing or clipping a portion of the applied waveform above or below a certain waveform. A positive clipper removes the positive half cycles of the applied input voltage. A negative clipper is one which removes the negative half cycles of the applied input voltage. The constructional difference between these two clippers is the way in which the diode is connected in the circuit or the polarities of the PN diode.

CIRCUIT DIAGRAM:

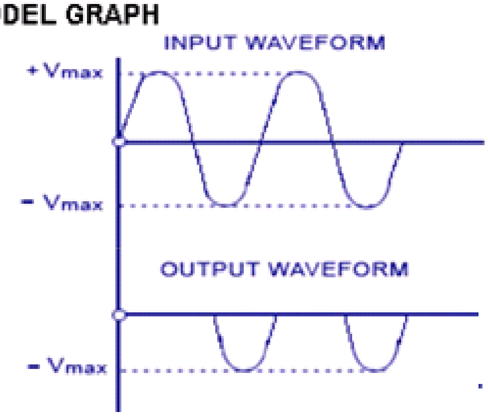


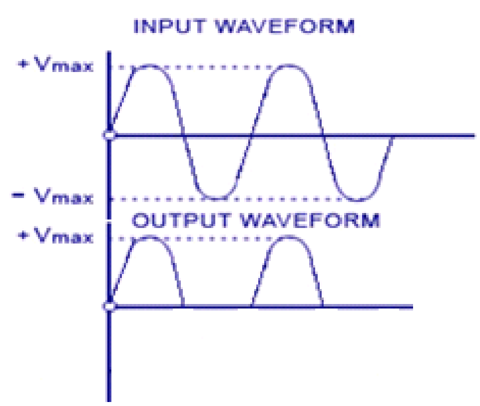
Positive clipper



Negative clipper

MODEL GRAPH





TABULATION

Sl.No.	Description	Time in mS		Amplitude in Voltage
		ON Time	OFF Time	
1	Input waveform			
2	Positive Clipper			
3	Negative Clipper			

PROCEDURE:
1. Check for the correct values of the required components.
2. Connect the circuit as per the circuit diagram.
3. Apply the source and note the corresponding output.
4. Draw the required graphs.

RESULT: Thus the required circuits for Clipper (Positive and Negative) are constructed and the required graphs are drawn.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: Where does these circuits are often used?

Expt. No 13

Date

DIODE APPLICATIONS (CLAMPING)

AIM:

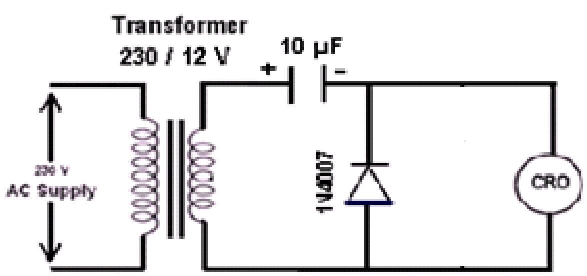
To construct circuits to function as Clamper (Positive and Negative) using diodes.

APPARATUS REQUIRED:

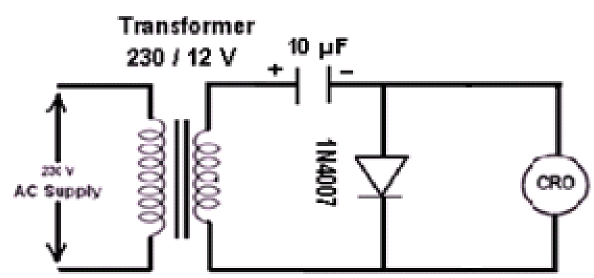
Sl.No.	Description	Range / Number/ Value	Qty
1	Diode	1N4007	2
2	Transformer	6-0-6 or 12-0-12	1
3	CRO	20 MHz	1
4	Capacitor	10 µF	1
5	Bread board and Connecting wires		

THEORY:

Clamper is a circuit which shifts the positive or negative peak of a signal at a desired DC level. A clamper essentially adds a DC component to the signal. In a clamper the shape of the original signal is not changed. Only its vertical shift is taking place. A Clamping circuit should not change the peak to peak value. The capacitor is used for adding the dc value and the resistor acts as the load.

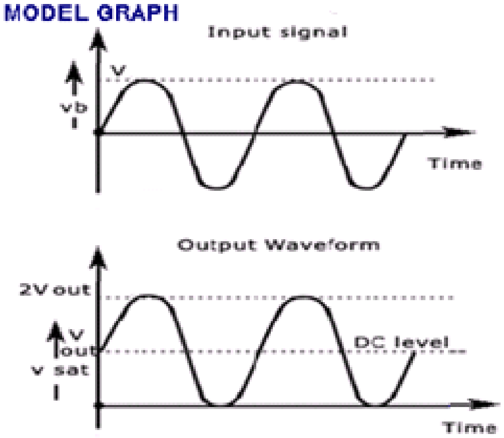


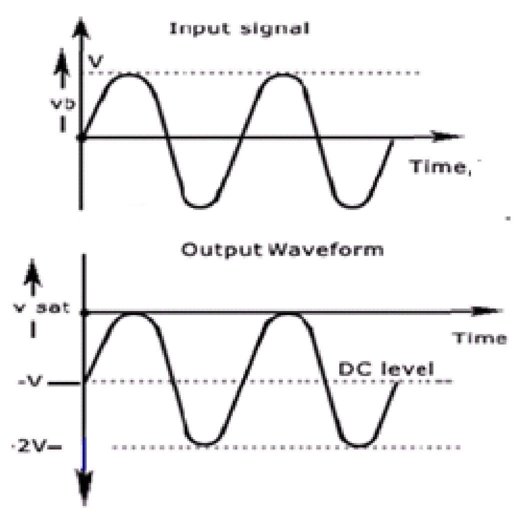
Positive Clamper



Negative Clamper

MODEL GRAPH





TABULATION

Sl.No.	Description	Time in mS		Amplitude in Voltage
		ON Time	OFF Time	
1	Input waveform			
2	Positive Clamper			
3	Negative Clamper			

PROCEDURE:

1. Check for the correct values of the required components.
2. Connect the circuit as per the circuit diagram.
3. Apply the source and note the corresponding output.
4. Draw the required graphs.

RESULT: Thus the required circuits for Clamper (Positive and Negative) are constructed and the required graphs are drawn.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: Where does these circuits are often used?

Expt. No 14
Date:

VOLTAGE MULTIPLIER

AIM: To construct the voltage multiplier circuits like **Doublers, Tripler** and **Quadruple** and verify their output.

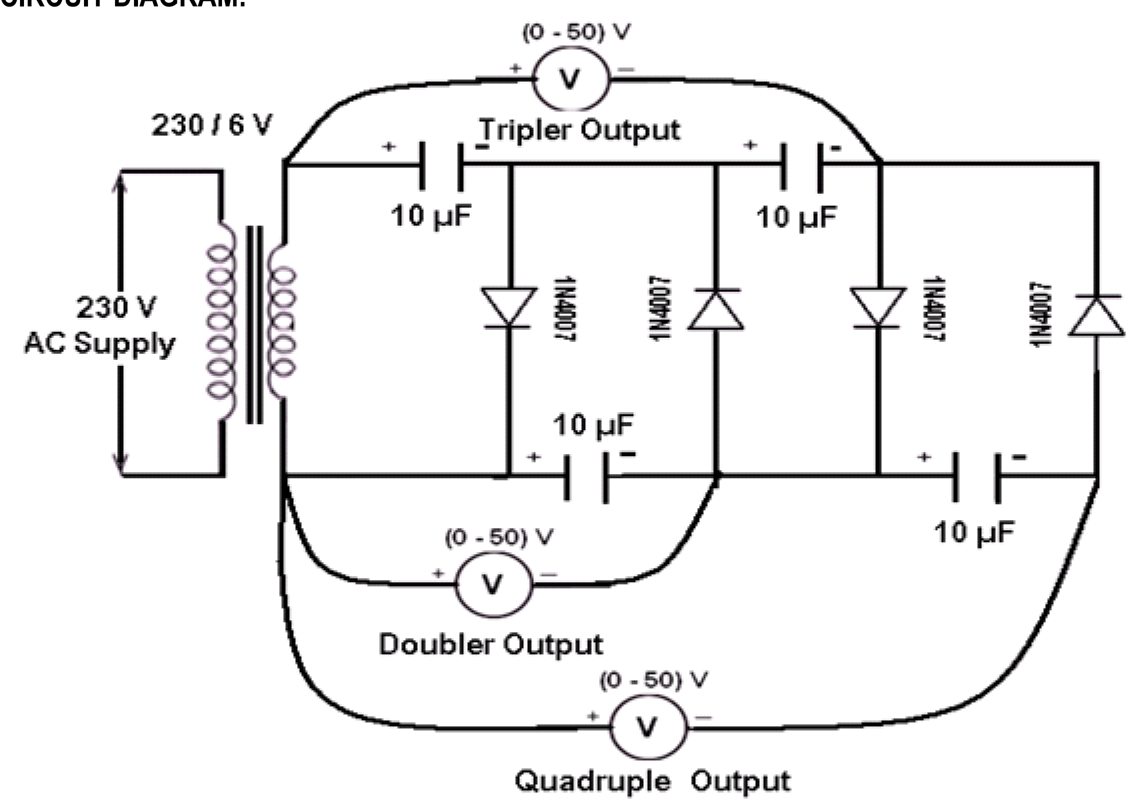
APPARATUS REQUIRED

Sl.No.	Description	Range / Number/ Value	Qty
1	Diode	1N4007	4
2	Transformer	6-0-6	1
3	Voltmeter	(0- 50) V	1
4	Capacitor	10 µF	4
5	Bread board and Connecting wires		

THEORY:

A capacitor charge pumps circuit which produces an output voltage which is twice the input voltage. Voltage **doublers** is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as at its input. The simplest of these circuits are a form of rectifier which take an AC voltage as input and output a doubled DC voltage. A voltage multiplier is an electrical circuit that converts AC electrical power from a lower voltage to a higher DC voltage, typically by means of a network of capacitors and diodes. These circuits are the extension of doublers circuit.

CIRCUIT DIAGRAM:



PROCEDURE:

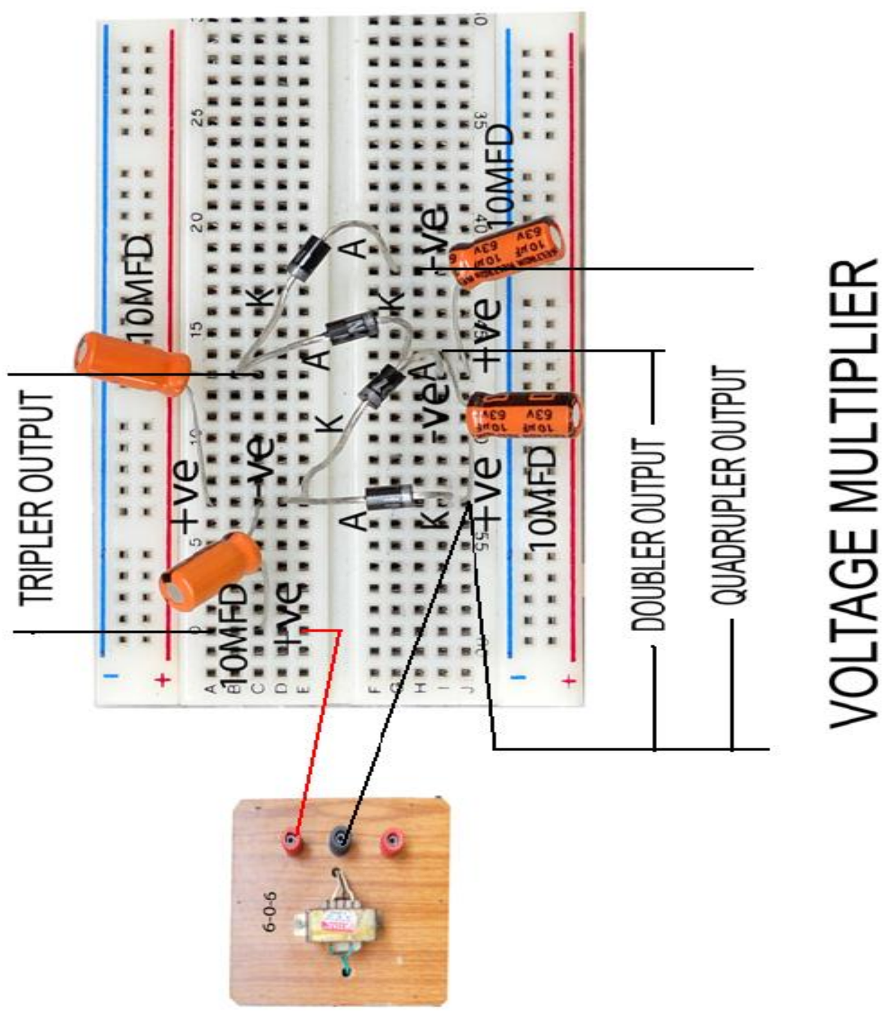
1. Connect the circuit as per the circuit diagram.
2. Apply the source and note the corresponding outputs.

TABULATION

Sl.No.	Description	Theoretical Voltage	Practical Voltage
1	Doubler	12 V	
2	Tripler	18 V	
3	Quadruple	24 V	

RESULTS: Thus the circuits of voltage multipliers are constructed and the outputs are verified.

BREAD BOARD CONNECTION



Expt.No:15

Date:

SWITCHING CHARACTERISTICS OF BJT

AIM: To build a circuit with BJT working as a switch and to plot the input and output waveforms.

To show that:

a) Switching the output to HIGH, whenever the input is Low.
b) Switching the output to LOW, whenever the input is HIGH.

APPARATUSREQUIRED:

Sl.No.	Description	Range / Number/ Value	Qty
1	Regulated Power supply	(0-30) V	1
2	Audio Oscillator/ Function Generator	1-100 KHz	1
3	Cathode Ray Oscilloscope (CRO)	20 MHz	1
4	Transistor	BC548 / SL100	1
5	Resistor	1KΩ,, 10KΩ,	Each one
6	Bread board and Connecting wires		

THEORY:

A major application of transistors as the switching device in computers and other control applications. In transistor, the output characteristics possess three different regions. They are,

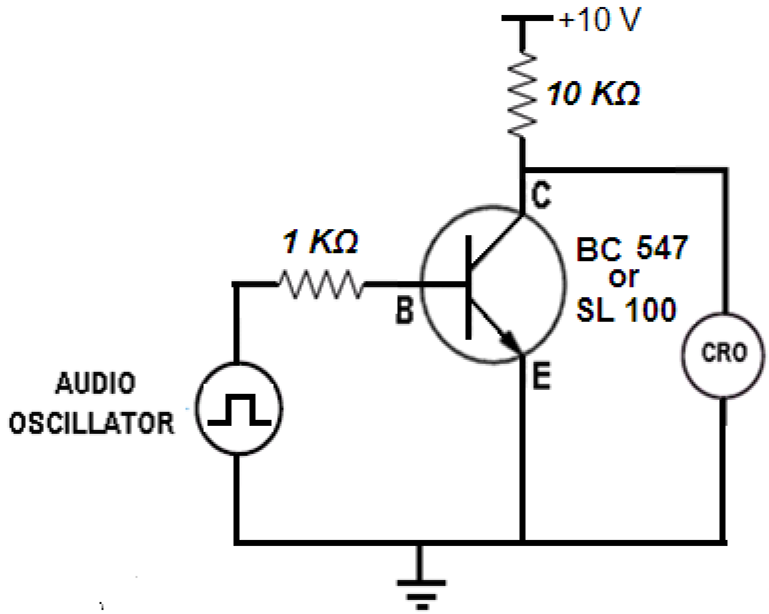
Cut - off region

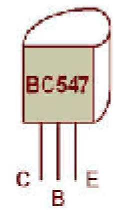
Active region

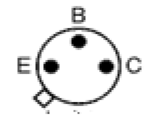
Saturation region

When the transistor is operating in cut off region, no current flows in the load circuit. The transistor thus behaves like an open switch. In this region both emitter-base junction and collector-base junction are reverse biased and no conduction will occur. When the transistor is operating in saturation region, it conducts just like a closed switch. Both emitter-base junction and collector-base junction remain Forward-biased and the device almost behaves like a Short-circuit. The region between cut-off region and Saturation region is termed as Active region. When the transistor is operating in this region, the emitter-base junction remains forward-biased and the collector-base junction remains Reverse-biased and it will be working as an Amplifier.

CIRCUIT DIAGRAM:

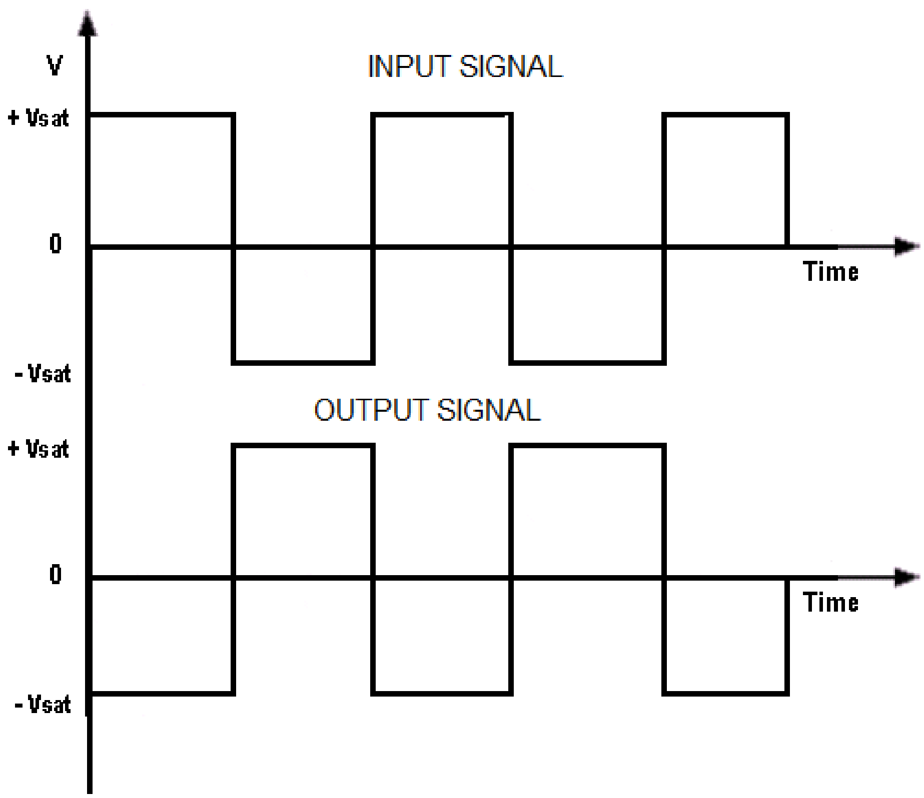






SL 100

MODEL GRAPH:



TABULATION

Sl.No.	Description	Time in mS		Amplitude in Voltage
		ON Time	OFF Time	
1	Input waveform			
2	Output Waveforms			

PROCEDURE:

1. Check for the correct values of the required components and make the connection as per the circuit diagram.
2. The Audio Oscillator / Function Generator has to be set with an input of 1V or 2V (Peak to peak) of Square wave at any frequency (1 – 10 KHz).
3. Apply the DC source to the circuit and the waveforms in the CRO (both input and output) should be observed in the dual trace mode simultaneously.
4. The waveforms are traced with its proper time period and amplitude values, from which the following observation to be made.
    1. Whenever the input is OFF state then the output is switched to ON state.
    2. Whenever the input is ON state then the output is switched to OFF state
5. Draw the graph of time versus voltage of the CRO observation taking time in X-axis and voltage in Y-axis for both input and output waveforms.

RESULT: The given transistor switching behavior is tested. The input and output waveforms of the electronic switching circuit are obtained for the given frequency.

Observations : Student is directed to write key observations of the experiment in the observation note book and understand the deviation from theory to practical (if any) and the reasons for this behavior.

SAQ: How the switching characteristics of BJT are different from JFET. Repeat the same experiment with JFET and observe the response.

FAQ FOR ELECTRONIC DEVICES LAB

1. Define depletion region of a diode.

In a semiconductor diode the **depletion region**, also called **depletion layer**, is an insulating region within a conductive, dopedsemiconductor material where the mobile charge carriers have diffused away, or have been forced away by an electric field. Large depletion regions inhibit current flowThe only elements left in the depletion region are ionized donor or acceptor impurities.

2. What is meant by transition & space charge capacitance of a diode?

During the reverse bias the minority carrier's move away from the junction, there by having uncovered immobile carriers on either side of the junction. Hence the thickness of the space charge layer at the junction increases with reverse voltage. This increase in uncovered charge with applied voltage may be considered a capacitive effect, endows the p-n junction with a capacitance, termed the transition, space - charge or depletion region capacitance. The internal capacitance C_T is given by

$$C_T = dQ / dV$$

wheredQ is the increase in charge caused by a change dVin voltage

3. Define cut-in voltage of a diode and specify the values for Si and Ge diodes.

The forward voltage at which the current through the P-N Junction starts increasing rapidly is called as Cut in voltage or knee voltage .The cut-in voltage for silicon is 0.7 voltandcut-in voltage for germanium is0.3volt.

4. What are the applications of a P-N Diode?

Varies applications of pn diode includes:-

- Rectifiers in dc power supplies
- Zener diodes in voltage regulators
- Tunnel diodes as a relaxation oscillator at microwave frequencies.
- Light emitter diode in digital displays.
- Clipping and clamping networks.
- Varactor diode in tuning sections of radio and TV receivers

5. What is PIV?

Peak Reverse Voltage' or **Peak Inverse Voltage** is the maximum voltage that a diode can withstand in the reverse direction without breaking down or avalanching[1] If this voltage is exceeded the diode may be destroyed

6. Differentiate between line regulation & load regulation?

- **Line regulation** defines the ability of a power-supply voltage to maintain the constant voltage level under change of input variation.
- **Load regulations** defined as the load increases or decrease the zener will control this variation by keeping the constant voltage.

7. What are the various regions in transistor characteristics?

Then bipolar transistors have the ability to operate within three different regions:

1. **Active Region** - the transistor operates as an amplifier and $Ic = \beta.Ib$
2. **Saturation Region** - the transistor is "fully-ON" operating as a switch and Ic = I(saturation)
3. **Cut-off Region** - the transistor is "fully-OFF" operating as a switch and Ic = 0

8. Define transistor configuration

A transistor has three terminals but we need two supplies hence four terminals to connect the transistor in a circuit. Therefore, one terminal of the transistor is kept common [The term common is used to denote the element that is common to both input and output circuits' arrangement is known as **configurations** of a transistor. The input is given between the common terminal and one of the two other terminals. Similarly, output is obtained between the common terminal and the left out third terminal. But remember that for satisfactory operation in all the configurations, the input side is to be forward biased and the output side is to be reversing biased. By keeping one transistor terminal common at a time, we can have three transistor configurations.

- **Common Base Configuration** - has Voltage Gain but no Current Gain.
- **Common Emitter Configuration** - has both Current and Voltage Gain.
- **Common Collector Configuration** - has Current Gain but no Voltage Gain.

9. What is the difference between diode and transistor?

Diodes and transistors are both made from semiconductors such as silicon or germanium. They are both made with p-type and n-type semiconductor layers to form PN junctions. P-types are positively charged, and n-types are negatively charged. However, they have many differences, including construction, operation and uses.

Sl. No.	**Description**	**Diode**	**Transistor**
1	**Construction**	Diodes are made from one PN junction. They have only two layers, and so have two terminals or leads	Transistors are made from one PN junction and one more n- or p-type. They have three layers, and so have three terminals or leads.
2	**Operation**	The current flow is only one direction.	The current flow through the middle layer controls the flow through the other two layers.
3	**Function**	Some of the many uses of diodes are as switches, current regulators or for conversion of AC current to DC current. Transistors are used as switches or amplifiers	Some of the many uses of diodes are as switches, current regulators or for conversion of AC current to DC current. Transistors are used as switches or amplifiers
4	**Uses**	Switches, current regulators or for conversion of AC current to DC current.	Switches , Amplifiers, Oscillator,voltage/current regulationand matching devices

10. What are the applications of CB configuration?

It is mainly used for **impedance matching**, since it has a low input resistance (30 ohms-160 ohms) and a high output resistance (250 kilohms-550 kilohms), for example to act as a preamplifier for moving-coil microphones.

Its **current gain of less than 1 (**approximately unity), so the CBconfiguration is also useful as a current buffer.

11. Define JFET

Junction field effect transistor. [JFET] is a solid state device that can be used as an electronically controlled switch.

12. Define α (alpha)?

The current gain in the common-base circuit is called Alpha. Alpha is the relationship of collector current (output current) to emitter current (input current). Alpha is calculated using the formula:

$$\alpha = \frac{\Delta I_C}{\Delta I_E}$$

For example, if the input current (I_E) in a common base changes from 1 mA to 3 mA and the output current (I_C) changes from 1 mA to 2.8 mA, the current gain (a) will be 0.90 or:

$$\alpha = \frac{\Delta I_C}{\Delta I_E} = \frac{18 \times 10^{-3}}{2 \times 10^{-3}} = 0.90$$

This is a current gain of less than 1.

13. What are the advantages of FET over BJT?

BJT is a bipolar device involving both types of charge carriers, where as FET is a unipolar device involving only one type of charge carrier. The main difference is that BJT is current controller device and FET is voltage controller device FET has high input impedance compared to BJT. FET has low noise compared to BJT. FET has low power dissipation compared to BJT. FET has better temp stability as compared to BJT. BJT is more temp sensitive than FET .BJT has better driving capability (fan-out) than feted bit also has high speed switching compared to FET

14. Define the following:

555IC TIMER: A semiconductor device that controls various modes of on/off states in electrical systems. The 555 timer is one of the most widely used types of integrated circuits.

AVALANCHE BREAKDOWN: A process that occurs in a diode when high voltage causes free electrons to travel at high speeds, colliding with other electrons and knocking them out of their orbits. The result is a rapidly increasing amount of free electrons.

SCR: A Silicon-Controlled Rectifier is a four-layer solid state device that controls current. An SCR consists of four layers of alternating P and N type semiconductor materials (PNPN) with three terminals: an input control terminal (gate), an output terminal (anode), and a terminal common to both the input and output (cathode).

DIAC:Diode alternating current switch [DIAC] is a semiconductor device that can conduct current in either direction, but not until breakdown voltage has been exceeded.

TRIAC: Triode alternating current switch [TRIAC] is a gated switching device that will conduct current in either direction.

DIGITAL IC: Digital ICs process only on/off signals. These devices can be found in microprocessors, memory chips, and microcomputers

FET: Field effect transistor. [FET] is a semiconductor device that outputs current in proportion to its input voltage. FETs use a small amount of control current to regulate a larger output current.

HOLDING CURRENT: The minimum current which must pass through a semiconductor device in order for it to remain in the ON state.

BREAK DOWN VOLTAGE: A term used to describe the level of AC or DC voltage that results in the failure of a semiconductor device. The voltage at which the breakdown occurs is called the breakdown voltage**MOSFET**: Metal oxide semiconductor field effect transistor [MOSFET] is a type of transistor that is controlled by voltage rather than current.

UJT: Unijunction transistor [UJT] is a voltage-controlled switch that controls current. The simplest application of a UJT is as a relaxation oscillator, which is defined as one in which a capacitor is charged gradually and then discharged rapidly.

LDR: It is abbreviated as LDR. **Light Dependent Resistor** is used to convert light into its corresponding resistance. Instead of directly measuring the light, it senses the heat content and converts it onto resistance.

15. JFET and MOSFET

1. JFETs can only be operated in the **depletion mode** whereas MOSFETs can be operated in either depletion or in **enhancement mode**. In a JFET, if the gate is forward biased, excess- carrier injunction occurs and the gate current is substantial. Thus channel conductance is enhanced to some degree due to excess carriers but the device is never operated with gate forward biased because gate current is undesirable.
2. MOSFETs have input impedance much higher than that of JFETs. This is due to negligibly small leakage current.
3. JFETs have characteristic curves more flat than those of MOSFETs indicating a higher drain resistance.

4. When JFET is operated with a reverse bias on the junction, the gate current I_G is larger than it would be in a comparable MOSFET. The current caused by minority carrier extraction across a reverse-biased junction is greater, per unit area, than the leakage current that is supported by the oxide layer in a MOSFET. Thus MOSFET devices are more useful in electrometer applications than are the JFETs.

For the above reasons, and also because MOSFETs are somewhat easier to manufacture, they are more widely used than are the JFETs.

16. What is the difference between UJT and BJT?

UJT (UniJunction Transistor): It is a transistor with only one junction and three terminals: an emitter (E)andtwo bases(B1andB2). BJT (Bipolar Junction Transistor): This type of transistor consists of two junctions and three terminals, namely Emitter "E", Base "B" and Collector"C". There are two types of BJT, i) PNP and ii) NPN.

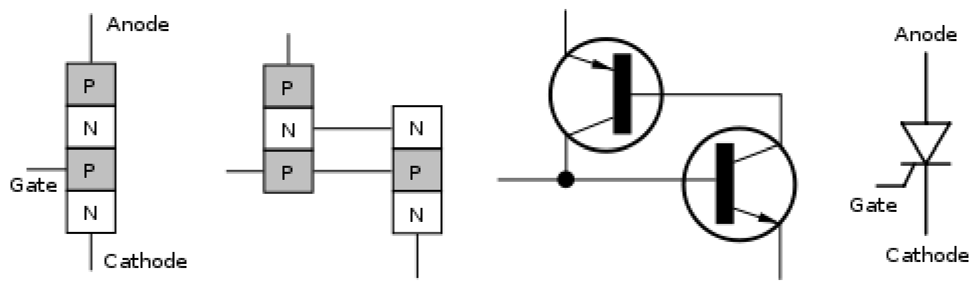
	Field Effect Transistor (FET)	**Bipolar Junction Transistor (BJT)**
1	Low voltage gain	High voltage gain
2	High current gain	Low current gain
3	Very input impedance	Low input impedance
4	High output impedance	Low output impedance
5	Low noise generation	Medium noise generation
6	Fast switching time	Medium switching time
7	Easily damaged by static	Robust
8	Some require an input to turn it "OFF"	Requires zero input to turn it "OFF"
9	Voltage controlled device	Current controlled device
10	More expensive than bipolar	Cheap
11	Difficult to bias	Easy to bias

17. Mention few applications of SCR.

SCR Application: SCRs are mainly used in devices where the control of high power, possibly coupled with high voltage, is demanded. Their operation makes them suitable for use in medium to high-voltage AC power control applications, such as lamp dimming, regulators Relay Controls, and Time – Delay Circuits, Regulated Power Suppliers, Motor Controls, Choppers, Inverters,Static Switches Phase Controls Heater Controls Emergency – Lighting System and motor control.

18. Define SCR

A **silicon-controlled rectifier** (or **semiconductor-controlled rectifier**) is a four-layer solid state device that controls current. The name "silicon controlled rectifier" or **SCR** is General Electric's trade name for a type of thyristor. An SCR consists of four layers of alternating P and N type semiconductormaterials (PNPN) with three terminals: an input **control** terminal (gate), an output terminal (anode), and a terminal common to both the input and output (cathode). Silicon is used as the intrinsic semiconductor, to which the proper dopants are added. The junctions are either diffused or alloyed.



19. Define resistive transducer

A resistive transducer is a device that senses a change in the environment to cause a change in resistance. Transducers do not generate electricity. Examples include:

Device	Action	Where used
Light Dependent Resistor	Resistance falls with increasing light level	Light operated switches
Thermistor	Resistance falls with increased temperature	Electronic thermometers
Strain gauge	Resistance changes with force	Sensor in an electronic balance
Moisture detector	Resistance falls when wet	Damp meter

These are called **passive** devices. (**Active transducers** do generate electricity from other energy sources.)

20. Define LDR.

LDR, an acronym for light dependent resistor is a resistor whose resistance is dependent on light. The resistance of LDR is of the order of Mega Ohms in the absence of light and reduces to a few ohms in presenceoflightLDRs are sensitive, inexpensive, and readily available devices. They have good power and voltage handling capabilities, similar to those of a conventional resistor. Their only significant defect is that they are fairly low acting, taking tens or hundreds of milli-seconds to respond to sudden changes in light level. Useful practical applications of LDR include light and dark-activated switches and alarms, light beam alarms and reflective smoke alarms etc.

21.Differentiate voltage doublers and voltage multiplier.

A capacitor charge pumps circuit which produces an output voltage which is twice the input voltage.
Voltage**doublers** is an electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case, exactly twice the voltage is produced at the output as at its input. The simplest of these circuits are a form of rectifier which take an AC voltage as input and output a doubled DC voltage.

A **voltage multiplier** is an electrical circuit that converts AC electrical power from a lower voltage to a higher DC voltage, typically by means of a network of capacitors and diodes.