JHARSUGUDA ENGINEERING SCHOOL, JHARSUGUDA

Lab Manual

ON

Fundamentals of Electronics Engineering

(1st & 2nd Semester)

DEPARTMENT

OF

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Experiment – 01

Aim of the experiment:

To identify various passive and active electronic components.

Components Required:

1. Resistors
2. Capacitors
3. Inductors
4. Diodes (Semiconductor diode, Zener Diode, LED, Photo Diode)
5. Transistors (BJT, JFET, MOSFET)

Theory:

1. Passive Components:

Those components which do not required external source for their operation are called passive components. A passive component does not provide any power gain to the circuit.
Example: Resistors, Capacitors, Inductors

a. Resistors:
A resistor is taken as a passive element since it cannot deliver any energy to a circuit. Instead resistors can only receive energy which they can dissipate as heat as long as current flows through it.

b. Capacitors:
A capacitor is considered as a passive element because it can store energy in it as electric-field. The energy dealing capacity of a capacitor is limited and transient – it is not actually supplying energy, it is storing it for later use.

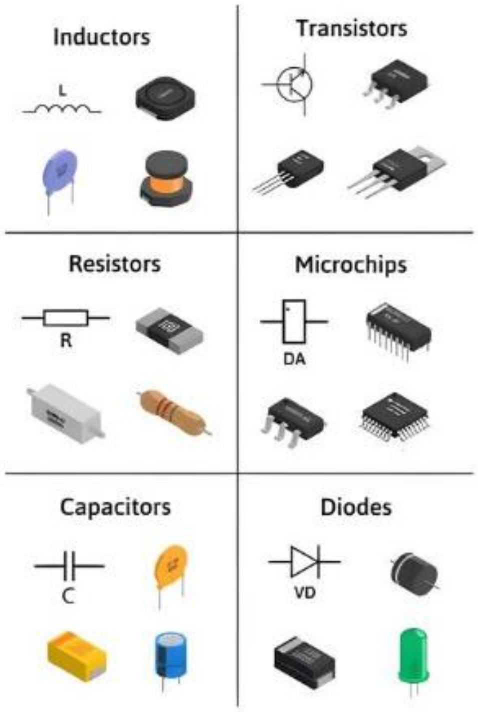
c. Inductors:
An inductor is also considered as passive element of circuit, because it can store energy in it as a magnetic field, and can deliver that energy to the circuit, but not in continuous basis. The energy absorbing and delivering capacity of an inductor is limited and transient in nature. That is why an inductor is taken as a passive **element of a circuit**.

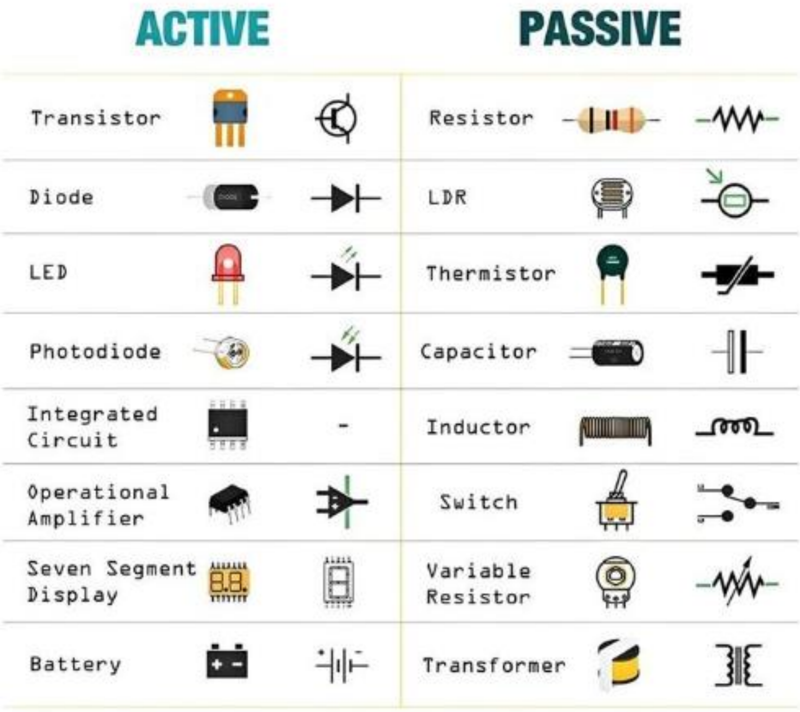
2. Active Components:

Those components which required external sources for their operation are called active components. An active component may provide power gain to the circuit.
Example: Diodes and Transistors.

a. Diodes (Semiconductor diode, Zener Diode, LED, Photo Diode):
A diode is a component capable of passing electric current in one direction but stopping current in the opposite direction (rectifying characteristics). This is done by combining semiconductors of type-p and type-n, and two types of materials, such as a semiconductor and a metal. LED (light-emitting diode) is also a type of diode, which is known for emitting light, but has the same characteristic of passing current only in one direction.

b. Transistors (BJT, JFET, MOSFET):
Transistors are semiconductor devices made by joining p-type and n-type semiconductors one after another and having three terminals called base (B), collector (C), and emitter (E). When a small current is applied between the base and emitter, a much larger current flows between the collector and emitter as an amplifying function. Similarly, a change in current between the base and emitter causes a large change in current between the collector and emitter as a switching function. Thus, transistors provide two functions. Transistors have a wide variety of applications, including an amplifier circuit, a switching circuit, a constant voltage circuit that suppresses power voltage fluctuation, and a logic circuit that uses input and output voltages for local operation.





Procedure:

1. Observe carefully the various components.
2. Identify value and type of resistors, inductors and capacitors and note them down in the observation table.
3. Identify component number and type of diodes and transistors and note them down in the observation table.

Precautions:

1. Ensure that any passive and active components taken for identification is put back at the right place.
2. Maintain neatness on the working table.
3. Handle the components properly.

Observations:

1. Observation table for Passive components

Sl. No.	Resistors		Capacitors		Inductors	
	Types	Values	Types	Values	Types	Values

2. Observation table for Active components

Sl. No.	Diodes		Transistors	
	Component No.	Values	Component No.	Values

Conclusion:

From the above experiment we identified various passive and active electronic components.

Experiment – 02

Aim of the experiment:

To connect resistors in series and parallel combination and measure its value using digital multimeter.

Components Required:

1. Digital Multimeter
2. DC power supply
3. Resistances two different values
4. Breadboard
5. Connecting wires: Single strand Teflon coating

Theory:

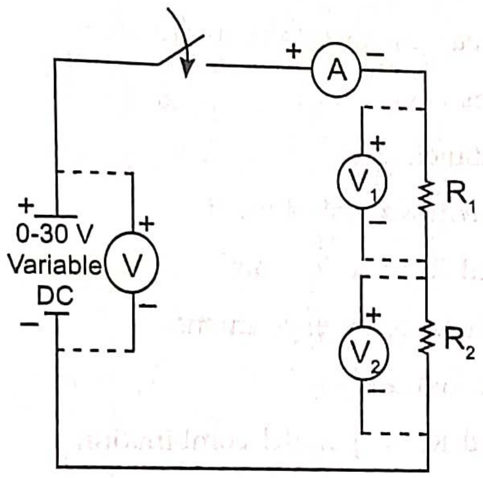
Any number of resistors can be connected in series. If N resistors are connected in series, the equivalent resistance is

$$R_{eq} = R_1+R_2+R_3+...+R_{N-1}+R_N=\sum_{i=1}^{N} Ri$$

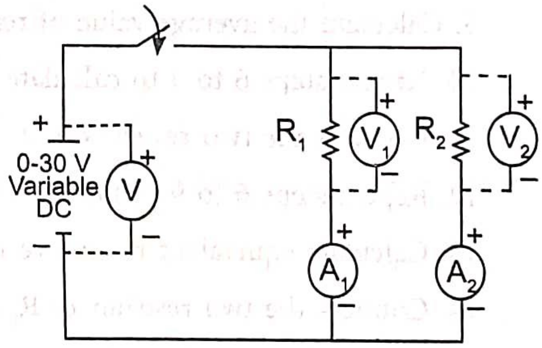
Any number of N resistors, the equivalent resistance Req of a parallel connection is related to the individual resistances by

$$Req = (\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \ldots\ldots\ldots + \frac{1}{RN-1} + \frac{1}{RN}) = \sum_{i=1}^{N} \frac{1}{Ri}$$

Practical Setup:



Series Circuit



Parallel Circuit

Procedure:

1. Connect the circuit on the breadboard as shown in the figure.
2. Connect the unknown Resistor R1 in the circuit
3. Connect the black lead to the COM terminal on the multimeter.
4. Connect the red lead to the Ω terminal on the multimeter.
5. Turn the multimeter on. The display window should indicate either 0L or OPEN.
6. Vary the voltage in the circuit using variable voltage supply.
7. Record the reading of voltage and current using the multimeter.

8. Calculate the resistance using Ohm's law.
9. Calculate the average value of resistance.
10. Repeat steps 6 to 9 to calculate unknown resistance R2.
11. Connect the two resistances R1 and R2 in series combination.
12. Repeat steps 6 to 9 to find out resistance by experiment.
13. Calculate equivalent resistance theoretically.
14. Connect the two resistances R1 and R2 in parallel combination.
15. Repeat steps 6 to 9 to find out resistance by experiment.
16. Calculate equivalent resistance theoretically.

Precautions:

1. Ensure that the connections should be as per the experimental setup.
2. While doing the experiment select proper function of multimeter.
3. Do not switch ON the multimeter unless you have checked the circuit connections.
4. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
5. Multimeter when used for measuring voltage across resistor should be connected in parallel with it.

Observation:

Sl.No.	**Voltage across Resistor R1**	**Current flowing with R1 in Circuit**	**Voltage across Resistor R2**	**Current flowing with R2 in Circuit**	**Voltage across R1 and R2 in series**	**Current flowing with R1 and R2 in series**	**Voltage across R1 and R2 in parallel**	**Current flowing with R1 and R2 in parallel**

Calculations:

Average value of R1 =
Average value of R2 =
Average value of equivalent resistance when R1 and R2 are in series =
Average value of equivalent resistance when R1 and R2 are in parallel =

Conclusion:

From the above experiment we connected resistors in series and parallel combination and measured its value using digital multimeter.

Experiment – 03

Aim of the experiment:

To connect capacitors in series and parallel combination and measure its value using multimeter.

Components Required:

1. Digital Multimeter
2. DC power supply
3. EMF Source
4. Capacitors in micro Farads of different values
5. Breadboard
6. Connecting wires: Single strand Teflon coating

Theory:

Series Capacitances

$$C_{total} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \dots \frac{1}{C_n}}$$

Parallel Capacitances

$$C_{total} = C_1 + C_2 + \dots C_n$$

Practical Setup:

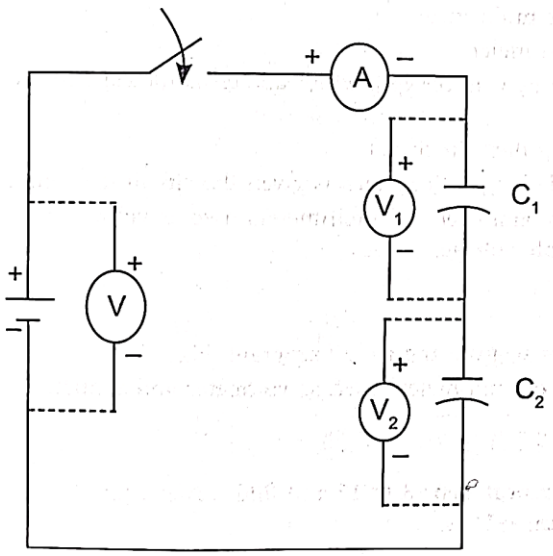


Fig. P9.1: Series combination of capacitors

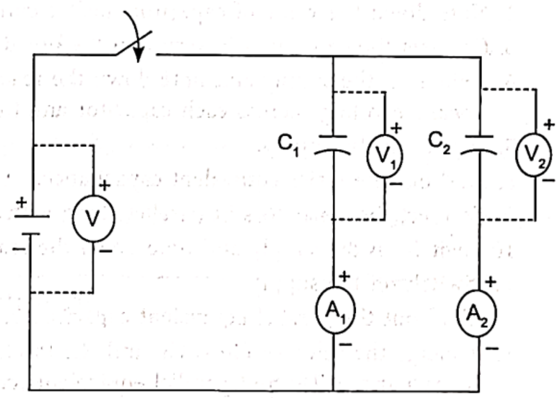


Fig. P9.2: Parallel combination of capacitors

Procedure:

1. Connect the black lead to the COM terminal on the multimeter.
2. Connect the red lead to the Ω terminal on the multimeter.
3. Make sure that each capacitor is discharged (V=0) by connecting a wire lead across the capacitor for about 30 seconds.
4. Note down the value of capacitors before connecting them in the circuit.
5. Connect the capacitors in series on the breadboard along with meters as given in the circuit diagram.
6. Switch on the supply and note down the readings of ammeter and multimeters used as voltmeter and measure voltage across each capacitor and supply voltage.
7. Switch off the supply.

8. Find out the series equivalent capacitance.
9. Connect the capacitors in parallel on the breadboard along with meters as given in the circuit diagram.
10. Switch on the supply and note down the readings of multimeters used as voltmeter and ammeter.
11. Switch off the supply.
12. Find out the parallel equivalent capacitance.
13. Change the value of C1 to C1'and C2 to C2' and repeat steps 3 to 12 and find series equivalent capacitance and parallel equivalent capacitance.

Precautions:

1. Do not switch ON the multimeter unless you have checked the circuit connections.
2. While doing the experiment select proper function of multimeter.
3. Ensure that all capacitors is discharged completely before connecting in the circuit.
4. Ensure that your hands are not wet while touching the circuit.

Observations:

1. C1= ______________________; C2=_____________________
2. C1'=______________________; C2'=____________________

Series connection

Sr. No.	V	V_1	V_2	I

Theoretically, for series connection

$V = V_1 + V_2$

$Q/C = Q/C_1 + Q/C_2$ i.e. $1/C = 1/C_1 + 1/C_2$

$$C_{TS1} = \frac{C_1 \times C_2}{C_1 + C_2} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

$$C_{TS2} = \frac{C_1' \times C_2'}{C_1' + C_2'} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

Parallel connection

Sr. No.	V	V_1	V_1	I_1	I_2

Theoretically, for parallel connection

$V = V_1 = V_2$

$Q = C(V_1 + V_2)$

$C_{TP1} = C_1 + C_2 =$ ________________________

$C_{TP2} = C_1' + C_2' =$ ________________________

Conclusion:

From the above experiment we connected capacitors in series and parallel combination and measure its value using multimeter.

Experiment – 04

Aim of the experiment:

Use multimeter to measure the value of given resistor and determine the value to confirm with colour code.

Components Required:

1. Digital Multimeter
2. Carbon resistors of different values and wattages

Theory:

A carbon resistor's outside is marked by three bands of different colours equidistant to each other and a fourth band slightly farther from the third compared to previous spacing as shown in Fig 13.1. The combination of the colours represents the value of the resistor in ohms. The bands are read from left to right, with the first two colour bands representing the base value as individual digits, while the third is a power multiplier and the last is a tolerance indicator because manufacturing process limits the preciseness of the value. If there are five bands, then the first three represent the base value, whereas the last two still represent the multiplier and tolerance, respectively.

Colour value representation:

0 = Black; 1 = Brown; 2 = Red; 3 = Orange; 4 = Yellow;
5 = Green; 6 = Blue; 7 = Violet; 8 = Grey; 9 = White

Tolerance:

Brown = +/- 1%; Red = +/- 2%; Gold = +/- 5%; Silver = +/- 10%

The power rating of a resistor is given in wattage. The normal available resistors have power ratings of 1/8 W, 1/4 W, 1/2 W, 1 W, 2 W.

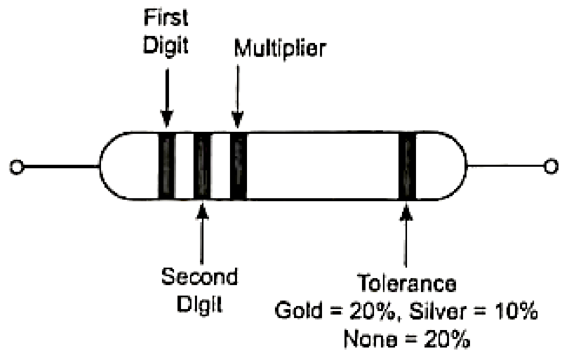


Fig. P13.1: Colour Coding of Resistors


Fig. P13.2: Resistance Measurement using Digital multimeter

Procedure:

1. Insert the red lead plug into the 'V' socket of the digital multimeter and the black lead plug into the 'COM' socket.
2. Set function to resistance measurement.
3. Set to the appropriate range.
4. Connect the two probes crocodile clips to the resistor via jumper wires to make measurement.
5. Note the reading, adjust range if necessary.
6. Determine the resistance value of various resistors using colour code and DMM.
7. Measure the resistance of each resistors and note the value in the observation table.
8. Compare the colour coded resistance value with measured value.
9. The measured resistance and colour coded resistance should agree with in the tolerance range of the resistor.

Precautions:

1. Ensure that both resistor leads are untouched while making the measurement, otherwise DMM will measure the body resistance as well as the resistor.
2. While doing the experiment select proper function of multimeter.

Observations:

Sr. No.	Resistance Value using Colour Code	Colour Coded Tolerance	Colour Coded Tolerance	Percentage Error
1.				

Calculation:

$$\text{Percentage Error} = \frac{\text{Measured value of resistance} - \text{Resistance value using colour code}}{\text{Measured value of resistance}} \times 100$$

Conclusion:

From the above experiment to measure the value of given resistor and determine the value to confirm with colour code.

Experiment – 05

Aim of the experiment:

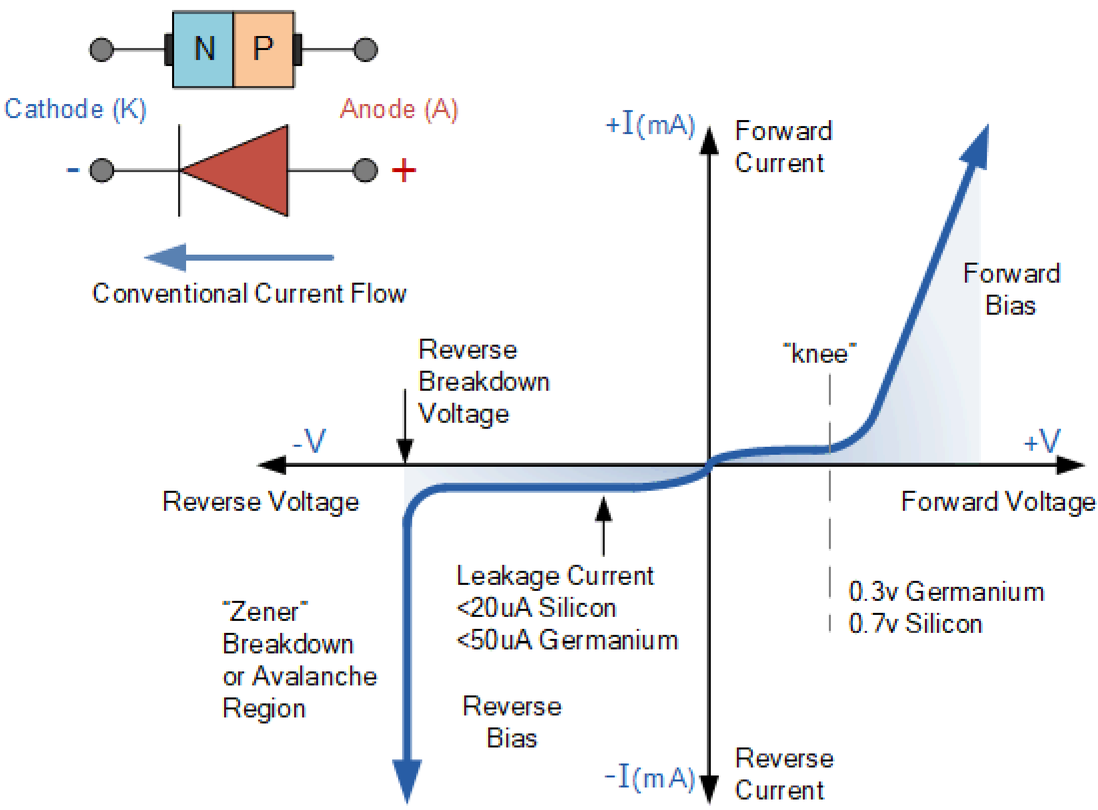
To test the PN-junction diode and LED using digital multimeter.

Components Required:

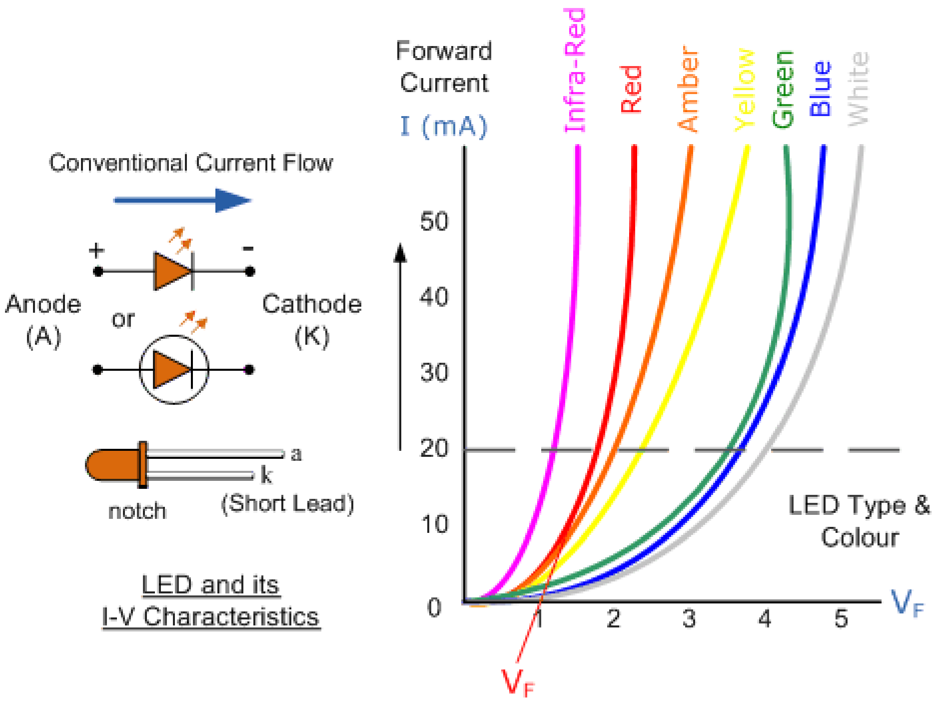
1. Digital Multimeter
2. DC regulated power supply
3. LED
4. Diode IN4007
5. Connecting wires: Single strand Teflon coating

Theory:

A PN Junction Diode is one of the simplest semiconductor devices around, and which has the electrical characteristic of passing current through itself in one direction only.A diode does not behave linearly with respect to the applied voltage. It has an exponential current-voltage (I-V) relationship.



The light emitting diode is the most visible type of semiconductor diode. They emit a fairly narrow bandwidth of either visible light at different coloured wavelengths, invisible infra-red light for remote controls or laser type light when a forward current is passed through them.



Practical Setup:

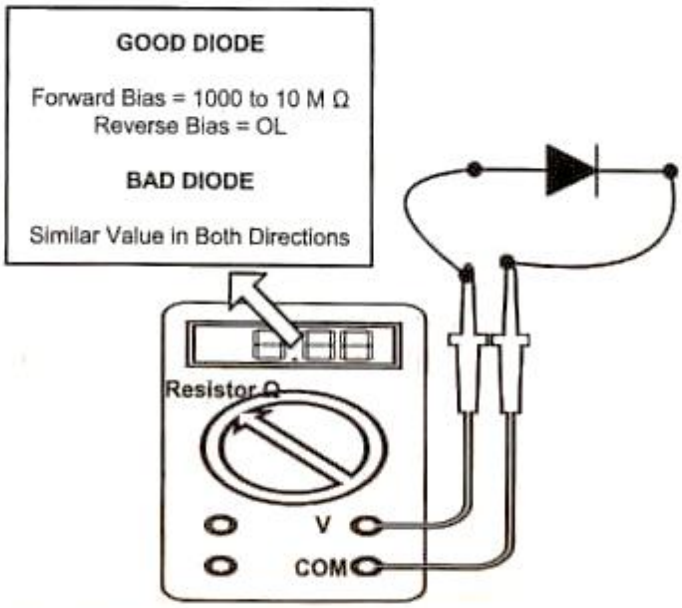


Fig. P14.1: Diode testing using digital multimeter

Fig. P17.1: Digital multimeter

Fig. P17.2: Image showing crocodile probes connected to LED

Procedure:

1. Procedure for PN Junction Diode

A. Direct diode test using digital multimeter:

1. Turn the dial (rotary switch) to Diode Test mode.
2. Connect the test leads to the diode. Record the measurement displayed.
3. Reverse the test leads. Record the measurement displayed.

B. Diode testing using resistance measurement mode:

1. Turn the dial to Resistance mode (Ω).
2. Connect the test leads to the diode after it has been removed from the circuit. Record the measurement displayed.
3. Reverse the test leads. Record the measurement displayed.
4. For best results when using the Resistance mode to test diodes, compare the readings taken with a known good diode.

2. Procedure for LED Diode

1. Connect the black lead to the COM terminal on the multimeter.
2. Connect the red lead to the Ω terminalon the multimeter.
3. Turn the dial to the diode symbol on the multimeter. This allows for electric current to flow in one direction and not the other.
4. Turn the multi-meter on. The display window should indicate either OL or OPEN.
5. Take a regular LED for testing.
6. Connect the black probe to the cathode end of the LED, which usually is the shorter end Connect the red probe to the anode end of the LED.
7. Observe the status of LED.
8. Read the forward voltage drop displayed on multimeter.
9. LED can be tested using D C power supply by connecting LED across positive and negative terminal of power supply.
10. Observe the status of LED and then repeat step 9 by reversing LED's terminals.

Precautions:

1. Make sure all power to the circuit is OFF.
2. No voltage exists at the diode.
3. Do not switch ON the multi-meter unless you have checked the circuit connections.
4. While doing the experiment select proper function of multimeter.
5. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

Observation:

A. Direct diode test

1. Multimeter display during forward biased condition ______ volt.
2. Multimeter display during reverse biased condition ______ volt.

B. Resistance Measurement test

1. Multimeter display during forward biased condition ______ ohms.
2. Multimeter display during reverse biased condition ______ ohms.

LED is ___________. (glowing /not glowing)

Conclusion:

From the above experiment we tested the PN-junction diode and LED using digital multimeter.

Experiment – 06

Aim of the experiment:

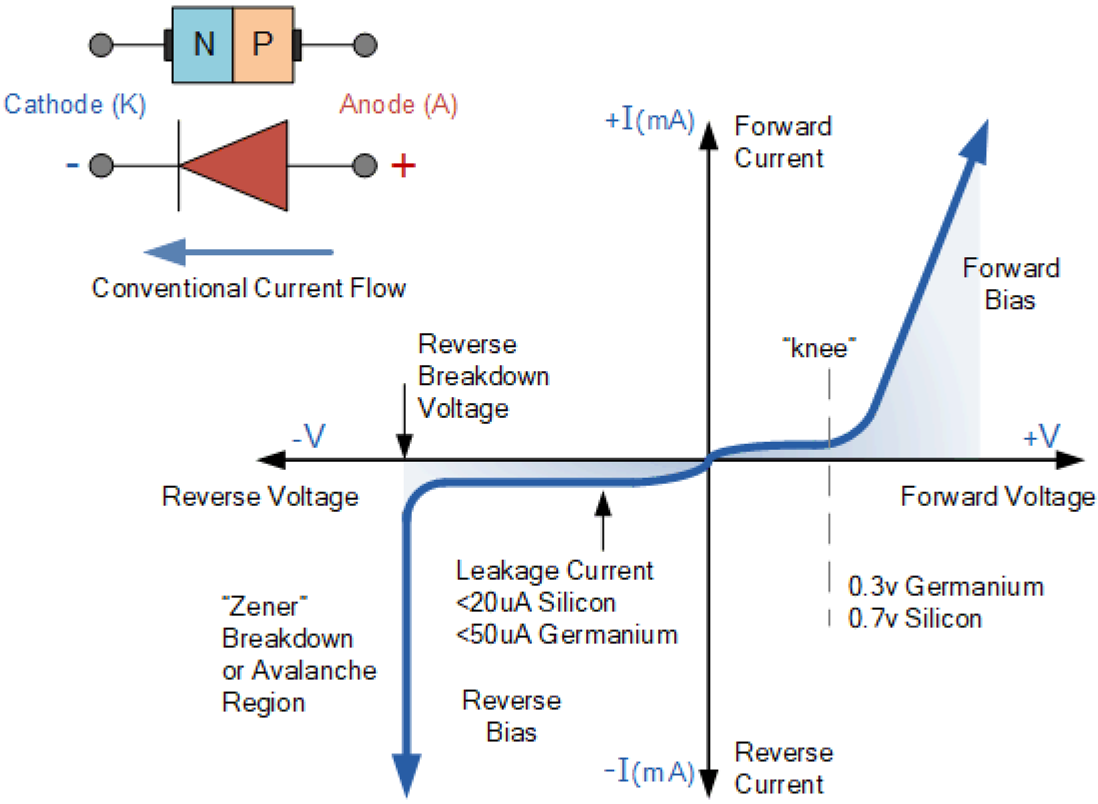
To test the performance of PN-junction diode.

Components Required:

1. Digital Multimeter
2. DC regulated power supply
3. Voltmeter
4. Ammeter
5. Breadboard
6. Diode: IN4007
7. Resistor: 1KΩ
8. Connecting wires: Single strand Teflon coating

Theory:

A PN Junction Diode is one of the simplest semiconductor devices around, and which has the electrical characteristic of passing current through itself in one direction only.A diode does not behave linearly with respect to the applied voltage. It has an exponential current-voltage (I-V) relationship.



Practical Setup:

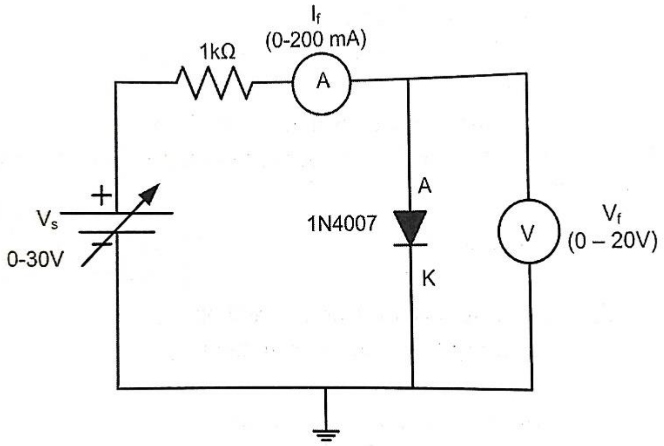


Fig. P15.1: Circuit diagram of diode in forward bias

Procedure:

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

Precautions:

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. Ensure that voltmeter and ammeter are connected in correct polarities as shown in the circuit diagram.
3. Ensure that the load resistance is of correct value and wattage.
4. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.
5. Ensure that the meter is in off condition before changing any range.

Observation:

Table 1: Measurement of V_F and I_F

Sr.No	V_F (volts)	I_F (mA)
1.		
2.		
3.		

Calculations:

Static resistance at a particular point

$$R_{static} = V_F/I_F$$

Dynamic resistance

$$R_{dynamic} = \Delta V_F/\Delta I_F$$

Results:

1. Static resistance of given diode =
2. Dynamic resistance of given diode=
3. Knee voltage of given diode=

Conclusion:

From the above experiment we tested the performance of PN-junction diode.

Experiment – 07

Aim of the experiment:

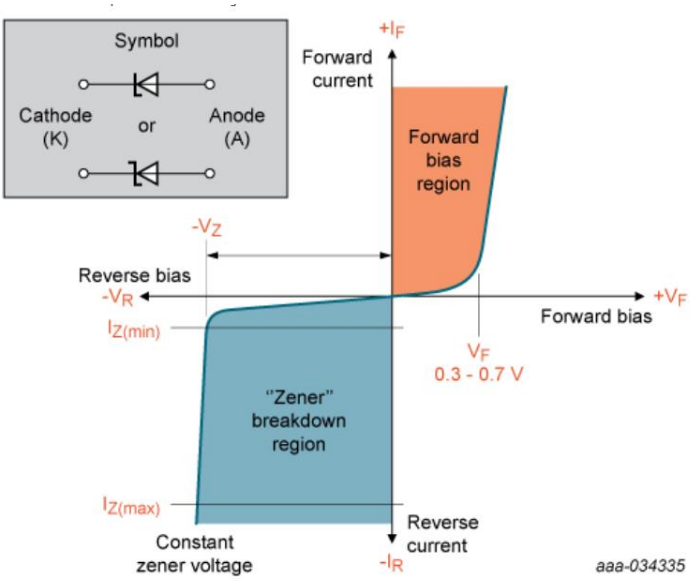
To test the performance of Zener diode.

Components Required:

1. Digital Multimeter
2. Variable DC Regulated power supply
3. Voltmeter
4. Ammeter
5. Breadboard
6. Zener Diode
7. Resistor: 1KΩ
8. Connecting wires: Single strand Teflon coating

Theory:

A Zener diode can be considered as a highly doped p-n junction diode which is made such that it works in reverse bias condition. When the potential reaches the Zener voltage which is also known as Knee voltage and the voltage across the terminal of the Zener diode is reversed, at that point time, the junction breaks down and the current starts flowing in the reverse direction. This effect is known as the Zener effect.



Practical Setup:

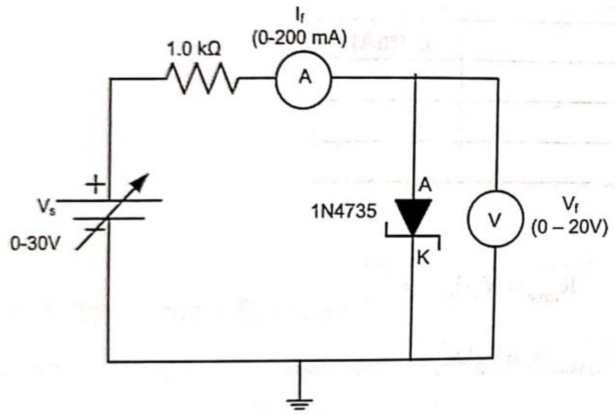


Fig. P16.1: zener diode in forward bias

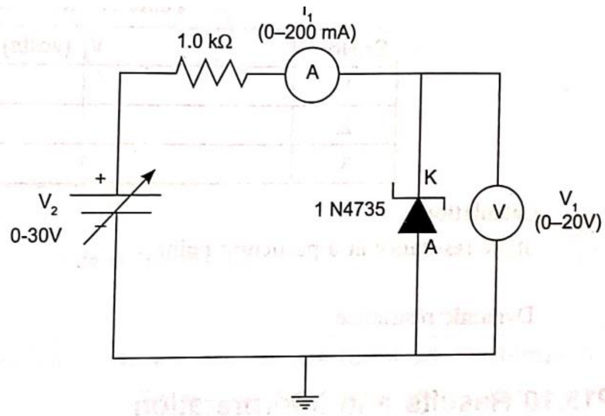


Fig. P16.2: zener diode in reverse bias

Procedure:

1. Connect the circuit as shown in the figure, 'Zener Diode in forward biased'.
2. Switch on the power supply.
3. Record the Voltage V_F and Current I_F in the observation table.
4. Increase the input voltage in step of 0.1V.
5. Record the Voltage V_F and Current I_F in the observation table.
6. Repeat step 4 to 5 till 1V is reached.
7. Plot the graph for the forward biased characteristics of diode by taking V_F on X-axis and I_F on Y-axis.
8. Connect the circuit as shown in the figure, 'Zener Diode in reverse biased'.
9. Vary input voltage gradually in steps of 1V up to 12V.
10. Record the corresponding readings of Voltage V_F and Current I_F in the observation table.
11. Plot the graph for the forward biased characteristics of diode by taking V_F on X-axis and I_F on Y-axis.

Precautions:

1. Do not switch on the power supply unless you have checked the circuit connections as per the circuit diagram.
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Ensure that the meter is in off condition while changing the range or settings.
4. Check for circuit continuity.

Observation and Calculations:

Table P16.1: Measurement of V_F and I_F

Sr.No.	V_F (volts)	I_F (mA)
1.		
2.		
3.		

Table P16.2: Measurement of V_R and I_R

Sr. No.	V_R (volts)	I_R (mA)
1		
2		
3		
4		
5		

Calculations:

Forward resistance at a zener diode

$$R_{static} = V_F/I_F$$

Dynamic resistance of zener diode in breakdown region at I = _________mA

$$R_{ZD} = V_R/I_R$$

Results:

1. Zener Breakdown Voltage =_____________
2. Forward resistance of Zener diode =____________

Conclusion:

From the above experiment we tested the performance of Zener diode.

Experiment – 08

Aim of the experiment:

To identify three terminals of a transistor using digital multimeter.

Components Required:

1. Single phase AC source
2. Connecting wires, Multistrand Cu wire
3. Digital Multimeter
4. Transistors small signal transistor (BC547, BC557)
5. Power Transistors (2N2955, 2N3055)
6. CRO

Theory:

Identifying Transistor Terminals:

Identifying Transistor Terminals:

The transistors are available with various packages in the market. Consider about the TO-92 package shown in Fig. P18.1. Keep the transistor such that the flat surface facing upwards .

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1. Internally the transistor has two diodes (NPN ≡ N - P - N ≡ NP Junction + PN Junction and PNP ≡ P - N - P ≡ PN Junction + NP Junction) i.e. emitter to base is one PN junction (diode) and base to collector is another PN junction (diode).
2. In the diode mode, the multimeter will show the voltage, when the positive probe of the multimeter is connected to the anode of the diode and negative probe to the cathode.
3. If the multimeter positive probe is connected to the cathode of the diode and the negative probe to the anode, then it will not give any voltage (showing zero).

Practical Setup:

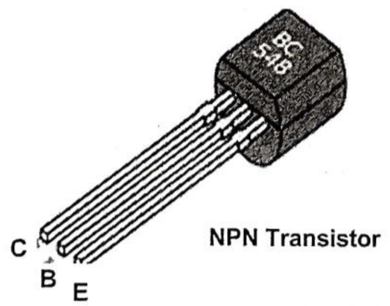


Fig. P18.1: TO-92 package of transistor

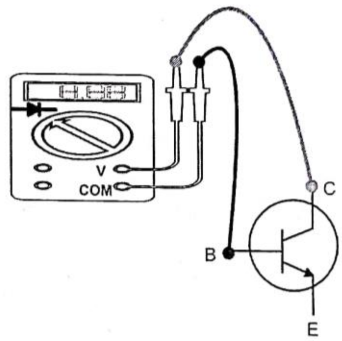


Fig. P18.2: NPN transistor meter check

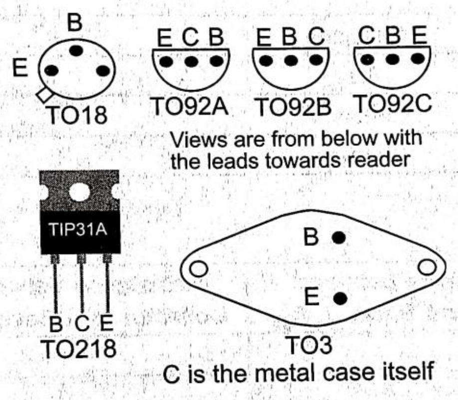


Fig. P18.3: Emitter, base and collector leads for some case styles

Procedure:

1. Set the multimeter to its ohm range.
2. Connect the circuit as shown in the figure.
3. Measured the resistance between base and emitter.
4. Measured the resistance between base and collector.
5. Measured the resistance between emitter and collector.
6. Verify the above steps with following chart
7. Change the transistor and repeat steps 2 to 6.

Between Transistor Terminals		PNP	NPN
Collector	Emitter	R_{HIGH}	R_{HIGH}
Collector	Base	R_{LOW}	R_{HIGH}
Emitter	Collector	R_{HIGH}	R_{HIGH}
Emitter	Base	R_{LOW}	R_{HIGH}
Base	Collector	R_{HIGH}	R_{LOW}
Base	Emitter	R_{HIGH}	R_{LOW}

Precautions:

1. Select proper type and of range of Digital Multimeter.
2. Connect the circuit as shown in the circuit diagram.
3. Switch OFF the power supply after conduction of experiment.

Observation:

Sr.No.	Transistor No.	Resistance between Emitter and Base, R_{BE}	Resistance between Collector and Base, R_{CB}	Resistance between Collector and Emitter, R_{CE}

Conclusion:

From the above experiment we identified three terminals of a transistor using digital multimeter.

Experiment – 09

Aim of the experiment:

To test the performance of NPN transistor.

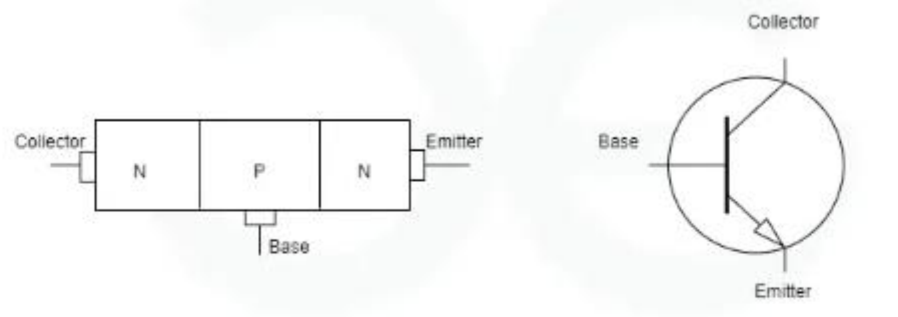
Components Required:

1. Digital Multimeter
2. DC regulated power supply
3. Voltmeter
4. Ammeter
5. Transistor
6. Resistor
7. Breadboard

Theory:

A bipolar junction transistor (BJT), a crucial semiconductor component of electronic circuits, is a type of transistor with NPN configuration. The way its three semiconductor layers are arranged is reflected in the name "NPN." a layer of the negative type (N) sandwiched between two layers of the positive type (P). The transistor can control the flow of electric current because of its layered structure, which serves as the foundation for its operation.

The collector-base junction is biased in the opposite direction. This indicates that the electron flow is inhibited by the voltage applied here. However, the electric field removes the majority of electrons that successfully cross the emitter-base junction across the collector-base junction, amplifying the current flowing from the emitter to the collector.



Practical Setup:

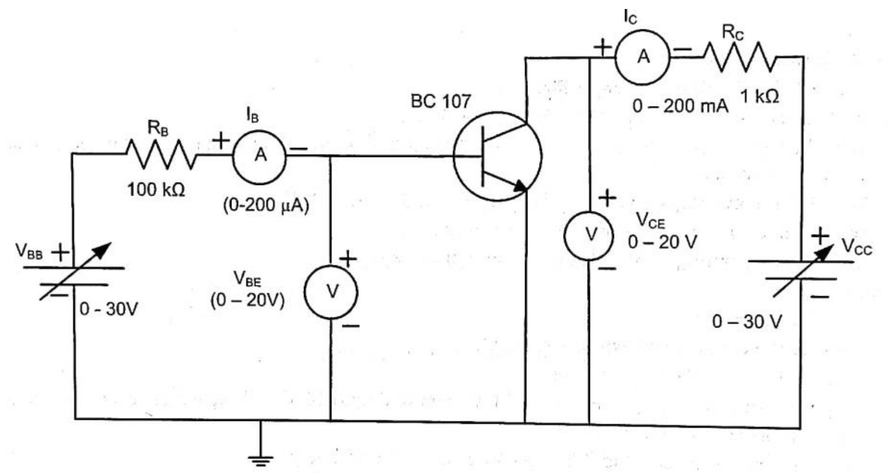


Fig. P19.1: Circuit diagram of BJT in CE mode

Procedure:

Part I

Input characteristics:

1. Connect the circuit as shown in Fig. P19.1.
2. Set VCE at constant voltage (2 V) by varying VCC.
3. Vary the input voltage VBE in steps of 0.1 V from 0 V up to 1V and record the corresponding value of I_B in observation table.
4. Repeat the above steps 2 and 3 by keeping V_{CE} at 5 V, and 10 V.
5. Sketch the characteristics from the recorded readings.
6. At suitable operating point calculate input resistance (ri).

Part II

Output characteristics:

1. Connect the circuit as shown in Fig. P19.1.
2. Set I_B constant at 10μA by varying V_{BB}
3. Vary the output voltage V_{CC} in steps of 1 V from 0 V upto 10 V and record the corresponding value of V_{CE} and I_C in observation table.
4. Repeat the above steps 2 and 3 by keeping I_B at 20 μA and 30 μA.
5. Sketch the characteristics from the recorded readings.
6. At suitable operating point calculate output resistance (r_o).

Precautions:

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the transistor beyond its rated voltage. This may lead to damage of the transistor.
3. Connect voltmeter and ammeter with correct polarities as shown in the circuit diagram.

Observations:

Sr. No.	V_{CE} = 2V		V_{CE} = 5V		V_{CE} = 10V	
	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)
1.						
2.						
3.						

Table P19.1: Input Characteristics

Sr. No.	I_B = 10μA		I_B = 20μA		I_B = 30μA	
	V_{CE}(V)	I_C(mA)	V_{CE} (V)	I_C(mA)	V_{CE} (V)	I_C(mA)
1.						
2.						

Table P19.2: Output Characteristics

Calculations: (from graph)

Input resistance R_i:

Output resistance R_o:

Current amplification factor α:

Results:

1. Input resistance R_i = Ω
2. Output resistance R_o = Ω
3. Current amplification factor β =………..…..

Conclusion:

From the above experiment we tested the performance of NPN transistor.