Mission of the Institute
To provide conducive environment for preparing competent, value added and patriotic engineers of integrity of par excellence to meet global standards for societal development.

Vision of the Institute
Today we carry the flame of quality education, knowledge and progressive technology for global societal development; tomorrow the flame will glow even brighter.

Mission of the Program
To provide student-centred conducive environment for preparing knowledgeable, competent and value-added electrical engineers

Vision of the Program
To emerge as the leading Electrical Engineering department for inclusive development of students.

Objectives of the Institute:
To impart innovative teaching and learning
To provide quality education with futuristic trends in engineering and technology
To develop the institute as a research centre for academic excellence
To ensure continual improvement in quality management system
To inculcate social values, patriotism and professional ethics among the students
Programme Educational Objectives (PEOs)

1. Core Knowledge

   Electrical engineering graduates will have the knowledge of basic science and engineering skills, humanities, social science, management and conceptual and practical understanding of core electrical engineering area with project development.

2. Employment

   Electrical engineering graduates will have the knowledge of Industry-based technical skills to succeed in entry level engineering position at various industries as well as in academics.

3. Professional Competency

   Electrical engineering graduates will have the ability to communicate effectively in English, to accumulate and disseminate the knowledge and to work effectively in a team with a sense of social awareness.
PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Apply principles of engineering, electronics and computer science; basic science, mathematics (including differential equations, discrete mathematics and linear algebra) and laboratory skills for building, testing, operation and maintenance of electrical systems.

2. Model, analyse, design, and realize physical systems, components or processes related to electrical engineering systems.

3. Be prepared to work professionally in power systems engineering, control systems engineering and software industries.

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engg. solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one”s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Course Outcomes:

Upon successful completion of lab Course, student will be able to:

1. Students will be able to demonstrate knowledge of circuit analysis using various basic laws and theorems of electrical circuits

2. Students will be able to demonstrate and understand definition and relationship of various AC circuits.

3. Understand working principle of PN junction diode, Zener diode and their applications.

4. Describe different configuration of Bipolar Junction Transistor.

5. Describe different configurations of FET

6. Understand operating principle Power Electronics Devices

7. Describe use of the Basic gate and Universal gate
Course Description:

In this laboratory course provides an introduction to electrical and electronics engineering which includes over view of electric power generation, single and three phase AC circuit, fundamentals of electrical installation, semiconductor devices such as diodes, transistor, FETs and Power Electronic devices, logic gates and their application.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Hours/week</th>
<th>No. of weeks</th>
<th>Total hours</th>
<th>Semester credits</th>
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<td>Lectures</td>
<td>03</td>
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<td>04</td>
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<tr>
<td>Tutorial</td>
<td>01</td>
<td>14</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

ESE Pattern: Oral [OR]

Prerequisite Course(s): Course on Physics at HSC level.

General Objectives:

1. To explain basic laws and theorems of electrical networks
2. To explain fundamentals alternating current circuits.
3. To provide students with a firm grasp of the essential principles of basic electronics.
4. To understand the concepts and terminology that is used in electronics engineering.
5. It is not an in-depth Electronic course but, rather a course aimed at acquiring an understanding of basic principles that are used in electronic engineering.

Learning Outcomes:
Upon successful completion of the lab student will be able to

1. Students will be able to demonstrate knowledge of circuit analysis using various basic laws and theorems of electrical circuits
2. Students will be able to demonstrate and understand definition and relationship of various AC circuits.
3. Understand working principle of PN junction diode, Zener diode and their applications.
4. Describe different configuration of Bipolar Junction Transistor.
5. Describe different configurations of FET
6. Understand operating principle Power Electronics Devices
7. Describe use of the Basic gate and Universal gate
SSBT’s College of Engineering & Technology, Bambhori, Jalgaon - 425001

Department of Electrical and Electronics & Telecommunication Engineering

Subject: Basic Electrical and Electronics Engineering Lab.
Class: F.E.

Full Name____________________________________________

Roll No________ University Exam No___________

Certificate

Certified that the following TERM WORK in Basic Electrical and Electronics Engineering Lab. is executed within the college premises and completed on___________ by Shri_________________________ of _____________ class.

Staff-member Incharge  Head of the Department  Principal
SSBT’s College of Engineering & Technology, Bambhori, Jalgaon - 425001
Department of Electrical and Electronics & Telecommunication Engineering

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<table>
<thead>
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<th>Expt. Nos.</th>
<th>Name of Experiments</th>
<th>Page Nos.</th>
<th>Date of Performance</th>
<th>Date of completion</th>
<th>Grade</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
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<td>2.</td>
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<tr>
<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<tr>
<td>8.</td>
<td></td>
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<tr>
<td>9.</td>
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</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

This is to certify that ____________________________ has performed the shown mentioned____________ experiments in the laboratory of the college of Engineering, Jalgaon.

Staff in- Charge                     Date_________                       HOD_________
EXPERIMENT NO. 01

OBJECTIVE: - Study and representation of electrical components/equipments

AIM: - To Identify & Test the Components

APPARATUS: - Resistors, Capacitors, Inductors, Multimeters etc.

THEORY:

A) Resistors:

Resistance is measured in ohms; the symbol for ohm is an omega (Ω). 1 Ω is quite small so resistor values are often given in kΩ and MΩ. 1kΩ = 1000Ω, 1MΩ = 1000000Ω.

- Color coding of resistors:
  Using color bands:
  3, 4, 5 bands Resistor values are normally shown using colored bands. Each color represents a number as shown in the table.
<table>
<thead>
<tr>
<th>Color of band</th>
<th>Value of 1&lt;sup&gt;st&lt;/sup&gt;, 2&lt;sup&gt;nd&lt;/sup&gt; digit</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>$10^0$</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>$10^{+1}$</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>$10^{+2}$</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>$10^{+3}$</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>$10^{+4}$</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>$10^{+5}$</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>$10^{+6}$</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>$10^{+7}$</td>
</tr>
<tr>
<td>Gray</td>
<td>8</td>
<td>$10^{+8}$</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>$10^{+9}$</td>
</tr>
<tr>
<td>Gold</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Silver</td>
<td>-</td>
<td>0.01</td>
</tr>
</tbody>
</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.
- The fourth band is used to shows the tolerance (precision) of the resistor, this may be ignored for almost all circuits but further details are given below.

The resistor shown below has red (2), violet (7), yellow (4 zeros) and gold bands. So its value is $270000 \, \Omega = 270 \, k\Omega$

B) Capacitors:

- Polarized capacitors (large values, 1µF +)
Examples

- Unpolarised capacitors (small values, up to 1µF)

Circuit symbol

Examples

- **Colour Coding of Capacitor** :- Note that colour code is same as that used for resistor & it is read in pico farad (pf) means multiply by $10^{-12}$ after digits.

C] **Inductors**:-

**Colour Coding of Inductor**:- Note that colour code is same as that used for resistor & it is read in microhenry means multiply by $10^{-6}$ after digits.
### Electrical symbols used for drawing schematic diagram

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Component name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Wire Symbol" /></td>
<td>Electrical Wire</td>
<td>Conductor of electrical current</td>
</tr>
<tr>
<td><img src="image2.png" alt="Connected Wires Symbol" /></td>
<td>Connected Wires</td>
<td>Connected crossing</td>
</tr>
<tr>
<td><img src="image3.png" alt="Not Connected Wires Symbol" /></td>
<td>Not Connected Wires</td>
<td>Wires are not connected</td>
</tr>
<tr>
<td><img src="image4.png" alt="Switch Symbol" /></td>
<td>SPST Toggle Switch</td>
<td>Disconnects current when open</td>
</tr>
<tr>
<td><img src="image5.png" alt="Switch Symbol" /></td>
<td>SPDT Toggle Switch</td>
<td>Selects between two connections</td>
</tr>
<tr>
<td><img src="image6.png" alt="Switch Symbol" /></td>
<td>Pushbutton Switch (N.O)</td>
<td>Momentary switch - normally open</td>
</tr>
<tr>
<td><img src="image7.png" alt="Switch Symbol" /></td>
<td>Pushbutton Switch (N.C)</td>
<td>Momentary switch - normally closed</td>
</tr>
<tr>
<td><img src="image8.png" alt="Switch Symbol" /></td>
<td>DIP Switch</td>
<td>DIP switch is used for onboard configuration</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td><img src="image" alt="SPST Relay" /></td>
<td>SPST Relay</td>
<td>Relay open / close connection by an electromagnet</td>
</tr>
<tr>
<td><img src="image" alt="SPDT Relay" /></td>
<td>SPDT Relay</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Jumper" /></td>
<td>Jumper</td>
<td>Close connection by jumper insertion on pins.</td>
</tr>
<tr>
<td><img src="image" alt="Solder Bridge" /></td>
<td>Solder Bridge</td>
<td>Solder to close connection</td>
</tr>
</tbody>
</table>

**Ground Symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Earth Ground" /></td>
<td>Earth Ground</td>
<td>Used for zero potential reference and electrical shock protection.</td>
</tr>
<tr>
<td><img src="image" alt="Chassis Ground" /></td>
<td>Chassis Ground</td>
<td>Connected to the chassis of the circuit</td>
</tr>
<tr>
<td><img src="image" alt="Digital / Common Ground" /></td>
<td>Digital / Common Ground</td>
<td></td>
</tr>
</tbody>
</table>

**Resistor Symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Resistor (IEEE)" /></td>
<td>Resistor (IEEE)</td>
<td>Resistor reduces the current flow.</td>
</tr>
<tr>
<td><img src="image" alt="Resistor (IEC)" /></td>
<td>Resistor (IEC)</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Potentiometer (IEEE)" /></td>
<td>Potentiometer (IEEE)</td>
<td>Adjustable resistor - has 3 terminals.</td>
</tr>
<tr>
<td><img src="image" alt="Potentiometer (IEC)" /></td>
<td>Potentiometer (IEC)</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Variable Resistor / Rheostat (IEC)" /></td>
<td>Variable Resistor / Rheostat (IEC)</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Trimmer Resistor" /></td>
<td>Trimmer Resistor</td>
<td>Preset resistor</td>
</tr>
<tr>
<td><img src="image" alt="Thermistor" /></td>
<td>Thermistor</td>
<td>Thermal resistor - change resistance when temperature changes</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td><img src="image" alt="Photoresistor / Light dependent resistor (LDR)" /></td>
<td>Photoresistor - change resistance with light intensity change</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Capacitor Symbols" /></td>
<td>Capacitor is used to store electric charge. It acts as short circuit with AC and open circuit with DC.</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Polarized Capacitor" /></td>
<td>Electrolytic capacitor</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Variable Capacitor" /></td>
<td>Adjustable capacitance</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Inductor / Coil Symbols" /></td>
<td>Coil / solenoid that generates magnetic field</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Iron Core Inductor" /></td>
<td>Includes iron</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Variable Inductor" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Power Supply Symbols" /></td>
<td>Generates constant voltage</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Current Source" /></td>
<td>Generates constant current.</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="AC Voltage Source" /></td>
<td>AC voltage source</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Generator" /></td>
<td>Electrical voltage is generated by mechanical rotation of the generator</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Battery Cell" /></td>
<td>Generates constant voltage</td>
<td></td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>🍃</td>
<td>Battery</td>
<td>Generates constant voltage</td>
</tr>
<tr>
<td>🔥</td>
<td>Controlled Voltage Source</td>
<td>Generates voltage as a function of voltage or current of other circuit element.</td>
</tr>
<tr>
<td>🌍</td>
<td>Controlled Current Source</td>
<td>Generates current as a function of voltage or current of other circuit element.</td>
</tr>
<tr>
<td>📊</td>
<td>Voltmeter</td>
<td>Measures voltage. Has very high resistance. Connected in parallel.</td>
</tr>
<tr>
<td>🔧</td>
<td>Ammeter</td>
<td>Measures electric current. Has near zero resistance. Connected serially.</td>
</tr>
<tr>
<td>🍊</td>
<td>Ohmmeter</td>
<td>Measures resistance</td>
</tr>
<tr>
<td>🛠️</td>
<td>Wattmeter</td>
<td>Measures electric power</td>
</tr>
<tr>
<td>🌟</td>
<td>Lamp / light bulb</td>
<td>Generates light when current flows through</td>
</tr>
<tr>
<td>🌟</td>
<td>Lamp / light bulb</td>
<td>Generates light when current flows through</td>
</tr>
<tr>
<td>🛠️</td>
<td>Motor</td>
<td>Electric motor</td>
</tr>
<tr>
<td>🍃</td>
<td>Transformer</td>
<td>Change AC voltage from high to low or low to high.</td>
</tr>
<tr>
<td>🛠️</td>
<td>Electric bell</td>
<td>Rings when activated</td>
</tr>
<tr>
<td>🛠️</td>
<td>Buzzer</td>
<td>Produce buzzing sound</td>
</tr>
<tr>
<td>Symbol</td>
<td>Component</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Fuse</td>
<td></td>
<td>The fuse disconnects when current above threshold. Used to protect circuit from high currents.</td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td>Contains several wires. Usually for data / address.</td>
</tr>
<tr>
<td>Opto-coupler / Opto-isolator</td>
<td></td>
<td>Optocoupler isolates connection to other board</td>
</tr>
<tr>
<td>Crystal Oscillator</td>
<td>Used to generate precise frequency clock signal</td>
<td></td>
</tr>
</tbody>
</table>

**Result:**

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

**Conclusion:**

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
QUESTIONS-

1. How to identify R, L & C values using colour coding technique?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

2. Why the multimeter indicate different values of resistance than colour codes?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Signature of subject teacher

Grade
EXPERIMENT NO. 02

OBJECTIVE: Verification of Thevenin's theorems

AIM: Verifications of Thevenin’s Theorem for two port network

APPARATUS: -

<table>
<thead>
<tr>
<th>S.NO</th>
<th>NAME OF THE EQUIPMENT</th>
<th>RANGE</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ammeter</td>
<td>(0-10) mA</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Voltmeter</td>
<td>(0-110)V</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Resistor</td>
<td>330Ω, 680Ω, 100Ω, 1KΩ</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Bread board</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Connecting wire</td>
<td>-</td>
<td>As per required</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM:

[Diagram showing a circuit with resistances and a 10V source]
To find Vth and Rth:

\[
\begin{align*}
\text{Rth} &= 680\Omega + 330\Omega \quad \text{(Equivalent Thevenin's resistance)} \\
V_{th} &= \frac{10V}{100\Omega + 680\Omega + 330\Omega} \\
\end{align*}
\]

To find IL:

\[
\begin{align*}
I_L &= \frac{V_{th}}{R_{th} + R_L} \\
\end{align*}
\]

**THEORY:**

**Thevenin’s theorem:** “The current through any load resistance, connected across any two points of an active network, can be obtained by dividing the potential difference between these two points with the load resistance disconnected (Equivalent Thevenin’s voltage, Vth), by the sum of load resistance and the resistance of the network measured between these points with load resistance disconnected and source of emf, replaced by their internal resistance (Equivalent thevenin’s resistance)”
If a load resistance RL is connected across output terminals, we can find the current through it

\[ I_L = \frac{V_{th}}{(R_{th} + RL)} \]

**PROCEDURE:**

1. Connections are made as per the circuit diagram.
2. Check your connections before switch on the supply.
3. Find the Thevenin’s voltage (or) open circuit voltage.
4. Replace voltage source by internal resistor.
5. Determine the Thevenin’s resistance.
6. Find \( I_L \) by using Thevenin’s formula
7. Compare the observation reading to theoretical value.
8. switch off the supply
9. Disconnect the circuit.

**OBSERVATION TABLE:**

<table>
<thead>
<tr>
<th></th>
<th>( V_{th} )</th>
<th>( R_{th} )</th>
<th>( I_L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CALCULATION:**

Find \( R_{th} \), \( V_{th} \) then find

\[ I_L = \frac{V_{th}}{(R_{th} + RL)} \]

**RESULT:**

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

_____

**CONCLUSION:**

____________________________________________________________________________________
QUESTIONS:

1. State the thevenin’s theorem?

2. Give the application of the thevenin’s theorem?

3. Explain the steps for solving the thevenins theorem?

Signature of subject teacher

Grade
OBJECTIVE: - Verification of Superposition theorems

AIM: - To verify the superposition theorem and determine the current following through the load resistance.

APPARATUS: -

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Equipment/component Name</th>
<th>Specification /value</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Voltmeter</td>
<td>0-120V</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Ammeter</td>
<td>0-20mA</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>Resistor</td>
<td>470Ω, 680 Ω</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Connecting wire</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM:
Case 1: To find $I_1$ when 10V source is acting alone:

```
+---+  +---+  +---+  +---+  +---+
| 10V |    |    | 680Ω |    | mA |
|     |    | 470Ω|    |    |    |
+-------+-------+-------+-------+-------+
```

Case 2: To find $I_2$ when 5V source is acting alone:

```
+---+  +---+  +---+  +---+  +---+
|    |    | 680Ω |    |    | mA |
| 470Ω |    |    | 470Ω |    | 5V |
+-------+-------+-------+-------+-------+
```

From Case 1 and Case 2: To find $I$ when two sources are acting:

```
+---+  +---+  +---+  +---+  +---+
| 10V |    |    | 680Ω |    | mA |
|     |    | 470Ω|    |    |    |
+-------+-------+-------+-------+-------+
```
**THEORY:**

Superposition theorem - “In a linear circuit containing more than one source, the current that flows at any point or the voltage that exists between any two points is the algebraic sum of the currents or the voltages that would have been produced by each source taken separately with all other sources removed”.

**PROCEDURE:**
1. Connections are made as per the circuit diagram.
2. Check your connections before switch on the supply.
3. Determine the current through the load resistance.
4. Now one of the sources is shorted and the current flowing through the resistance $I_L$ measured by ammeter.
5. Similarly, the other source is shorted and the current flowing through the resistance $I_L$ Measured by ammeter.
6. Compare the value obtained with the sum of $I_1$&$I_2$ should equal to $I$
7. Compare the observation reading to theoretical value.
8. Switch off the supply
9. Disconnect the circuit.

**OBSERVATION TABLE:**

<table>
<thead>
<tr>
<th></th>
<th>$I_1$</th>
<th>$I_2$</th>
<th>$I$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CALCULATION:**

Find the current flowing through 680Ω i.e. $I_1$ considering only one source. Similarly find the $I_2$ considering other source. Then, total current flowing through the 680Ω

$$I = I_1 + I_2$$
RESULT:

CONCLUSION:

QUESTIONS:

1. State the superposition theorem?

2. Define linear and bilateral network?

3. Define active and passive network?

Signature of subject teacher

Grade
EXPERIMENT NO. 04

OBJECTIVE: - Verification of Maximum power transfer theorems

AIM:- To verify Maximum power transfer theorem by practical and analytical method

APPARATUS: -

1. DC Supply
2. Voltmeter
3. Ammeter
4. Resistor
5. Bread board

THEORY:

In a resistive circuit, a resistive load receives maximum power when the load resistance is equal to the Thevenin’s equivalent resistance of the circuit (i.e. \( RL = R_{TH} \)). Or load resistance is equal to internal resistance of source.

If the source impedance has a resistive and reactive parts, the maximum power is transferred to the load (actually to the resistive part of the load) when the load resistance equal the source resistance and the load reactance is opposite to the source reactance.

- Maximum Power Transfer Theorem
Suppose we have a voltage source or battery that's internal resistance is $R_i$ and a load resistance $R_L$ is connected across this battery. **Maximum power transfer theorem** determines the value of resistance $R_L$ for which, the maximum power will be transferred from source to it. Actually the maximum power, drawn from the source, depends upon the value of the load resistance. There may be some confusion let us clear it.

**CIRCUIT DIAGRAM:**

![Circuit Diagram](image)

**PROCEDURE:**

1. Make the connection as per circuit diagram.
2. Change the load resistance in steps and measure corresponding voltage, current and power.

**OBSERVATION TABLE:**

<table>
<thead>
<tr>
<th>Load Resistance</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CALCULATION:

RESULT:

CONCLUSION:

QUESTIONS:
1) State the Maximum Power Transfer Theorem.

2) Define Electrical Power and its classification.

Signature of subject teacher

Grade
EXPERIMENT NO. 5

AIM: To plot the V-I characteristics of P-N junction diode.

OBJECTIVES:
1) To plot forward characteristics of P-N junction diode.
2) To plot reverse characteristics of P-N junction diode.
3) To determine static resistances of diode

APPARATUS:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of instrument</th>
<th>Ratings</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Experimental Kit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2)</td>
<td>Power Supply</td>
<td>(0-30V)</td>
<td>01</td>
</tr>
<tr>
<td>3)</td>
<td>Multimeter</td>
<td>Digital</td>
<td>02</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM:
THEORY:

Forward Characteristics of PN Junction Diode:

Figure (a) shows the circuit arrangement for obtaining forward characteristics of a diode. In this circuit, diode is connected to a d. c. supply. A voltmeter is connected across the diode to measure the voltage whereas the milliammeter measures the current in the circuit. The positive terminal of voltage source connected to the anode of a diode and negative terminal to the cathode. Hence the diode is forward biased. The voltage at which diode starts conducting is called Knee Voltage. The Knee voltage is designated either by $V_k$. Its value is 0.6V for Si and 0.2V for Ge.

Reverse Characteristics of PN Junction Diode:

The negative terminal of voltage source is connected to the anode of the diode and positive terminal to cathode. Hence diode is reverse bias. The reverse characteristics indicate that when the applied reverse voltage is below breakdown voltage ($V_{BR}$), the diode current is small and remains constant. This value of current is called Reverse Saturation current ($I_0$). When the reverse voltage is increased to a sufficiently large value, the diodes reverse current increases rapidly. The applied reverse voltage at which this happens, is known as breakdown voltage ($V_{BR}$) of a diode.

PROCEDURE:

For Forward Characteristics:

1. Connect the circuit as shown in the fig 1.
2. Increase $V_{in}$ in regular intervals and note the readings of $V_F$ and $I_F$.
3. Draw the characteristics between $V_F$ & $I_F$.
4. Calculate static resistance from the characteristics.

For Reverse Characteristics:

1. Connect the circuit as shown in the fig 2.
2. Increase $V_{in}$ in regular intervals and note the readings of $V_R$ and $I_R$.
3. Draw the characteristics between $V_R$ & $I_R$. 
**OBSERVATION TABLE:**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>V</th>
<th>$V_F$ (Volts)</th>
<th>$I_F$ (mA)</th>
<th>$V$</th>
<th>$V_R$(Volts)</th>
<th>$I_R$ (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.2</td>
<td></td>
<td>.5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.4</td>
<td></td>
<td>1.5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.6</td>
<td></td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>.8</td>
<td></td>
<td>2.5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td>3</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.5</td>
<td></td>
<td>3.5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td></td>
<td>4</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESULT:**

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

**CONCLUSION:**

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________
ORAL BASED QUESTIONS:

1) Define depletion region and barrier potential.
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________

2) What is Knee voltage and define its magnitude for Si & Ge?
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________

3) Explain reverse saturation current and reverse breakdown voltage.
__________________________________________________________
__________________________________________________________
__________________________________________________________
__________________________________________________________

Signature of subject teacher

Grade
EXPERIMENT NO. 06

AIM: To determine the operating point of BJT.

OBJECTIVE: 1) Determination of parameters in cut off region.

2) Determination of parameters in saturation region.

3) Understanding of Q point.

APPARATUS:

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Name of instrument</th>
<th>Ratings</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Experimental Kit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2)</td>
<td>Power Supply</td>
<td>(0 -30V), 2amp</td>
<td>01</td>
</tr>
<tr>
<td>3)</td>
<td>DMM</td>
<td></td>
<td>02</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM:
THEORY:
The load line is the line drawn by joining all the operating points for different values of $I_B$ on output characteristics of common emitter configuration. The load line is plotted by knowing only two points, a Saturation point and a Cutoff point. The Q-point of given circuit is located on the load line. For faithful amplification it is necessary to place the Q-point at the center of load line.

PROCEDURE:
1. Connect the circuit as shown in figure.
2. Switch on the supply.
3. Note the readings on current meter and voltmeter as an operating point.
4. Now short CE terminals and note the reading on current meter as $I_{c_{sat}}$.
5. Now set $I_c = 0$ and note $V_{CE_{cutoff}}$.
6. Draw the load line and locate the Q-point on load line.

OBSERVATION TABLE:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>$I_{cQ}$</th>
<th>$V_{CEQ}$</th>
<th>$I_{c_{sat}}$</th>
<th>$V_{CE_{cutoff}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESULT:  

|         |          |           |               |                  |
|         |          |           |               |                  |
|         |          |           |               |                  |
|         |          |           |               |                  |

CONCLUSION:  

|         |          |           |               |                  |
|         |          |           |               |                  |
|         |          |           |               |                  |
|         |          |           |               |                  |
|         |          |           |               |                  |
**ORAL BASED QUESTION:**

Q.1. Define load line & operating point?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Q.2. Where should be the Q-point located for faithful amplification?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Q.3. What is stability factor?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Signature of subject teacher

Grade
EXPERIMENT NO. 07

AIM: To plot the characteristics of Light Emitting Diode (LED)

OBJECTIVE: 1) To plot forward characteristic of Light Emitting Diode (LED)

                      2) To study difference of this characteristics with P-N junction diode characteristics.

APPARATUS:

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Name of instrument</th>
<th>Ratings</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Experimental Kit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2)</td>
<td>Power Supply</td>
<td>(0 - 30V), 2amp</td>
<td>01</td>
</tr>
<tr>
<td>3)</td>
<td>DMM</td>
<td></td>
<td>02</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM:
THEORY: LED is the type of diode which emits light when forward biased. In the symbol arrows on the diode signifies the emission of light. The light intensity increases with increasing current through the diode. The minimum voltage required for the diode to conduct is 1.5V. The colour of emitted light depends on the material used for construction. The emitted light is in the colours Red, Yellow, Green, Blue as well as Ultraviolet. The LED is used mainly to indicate ON/OFF position of equipment. It is also used in many advertising applications, electronics and communication equipments.

PROCEDURE:

1) Connect the circuit as shown in the fig.

2) Increase $V_{in}$ in regular intervals and note the readings of $V_F$ and $I_F$.

3) Draw the characteristics between $V_F$ & $I_F$.

OBSERVATION TABLE:

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>$V_{in}$</th>
<th>$V_F$ (volts)</th>
<th>$I_F$ (milli Amp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESULT: ________________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
CONCLUSION:

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

ORAL BASED QUESTION:
Q.1. Differentiate between LED & Photodiode.
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Q.2. Define the materials used for colour emission.
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Q.3. How the characteristics of LED differs than the characteristics of P-N junction diode?
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
**EXPERIMENT NO. 08**

**AIM:** To implement any Boolean expression using logic gates.

**OBJECTIVES:**

1) Simplification of Boolean expression.
2) Implementation using basic gates.
3) Implementation using Universal gates.

**APPARATUS:**

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Name of instrument</th>
<th>Ratings</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Experimental Kit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2)</td>
<td>Power Supply</td>
<td>(0 -30V), 2amp</td>
<td>01</td>
</tr>
</tbody>
</table>

**THEORY:**

A logic gate is an idealized or physical device implementing a Boolean function, that is, it performs a logical operation on one or more logic inputs and produces a single logic output.

**NOT gate (inverter)**

The output Y is true when the input A is NOT true; the output is the inverse of the input:

\[ Y = \overline{A} \]

A NOT gate can only have one input. A NOT gate is also called an inverter.
**AND gate**

The output Y is true if input A and input B both true:

\[ Y = A \text{ AND } B \]

An AND gate can have two or more inputs.
Its output is true if all inputs are true.

**NAND gate (NAND = NOT AND)**

This is an AND gate with the output inverted, as shown by the bubble on the output.
The output is true if input A AND inputs B are NOT both true:

\[ Y = \text{NOT} (A \text{ AND } B) \]

A NAND gate can have two or more inputs.
Its output is true if NOT all inputs are true.

**OR gate**

The output Y is true if input A OR input B is true (or both of them are true)

\[ Y = A \text{ OR } B \]

An OR gate can have two or more inputs.
Its output is true if at least one input is true.

**NOR gate (NOR = Not OR)**

This is an OR gate with the output inverted, as shown by bubble on the output.
The output Y is true if NOT inputs A OR B is true: \( Y = \text{NOT} (A \text{ OR } B) \)
A NOR gate can have two or more inputs; its output is true if no inputs are true

**Implementation of the logic function**

\[ Y = AB + \overline{AB} \]

Gate using basic gates.
Implementation of the logic function - \( Y = \overline{AB} + A \overline{B} \) using NAND Gate.

**Procedure:** Implement the given Boolean expression using basic & universal gates and verify the results using truth tables.

**RESULT:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

**CONCLUSION:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
ORAL BASED QUESTIONS:

1) Draw the symbol and equation of basic gates?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2) Why NAND & NOR are called as Universal gates?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3) Implement OR gate using NAND gate.

________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Signature of subject teacher

Grade