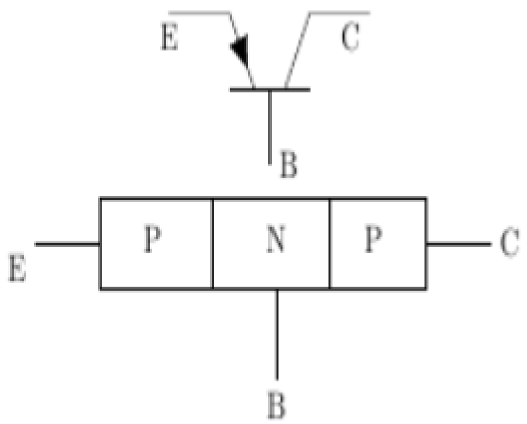
CONTENTS

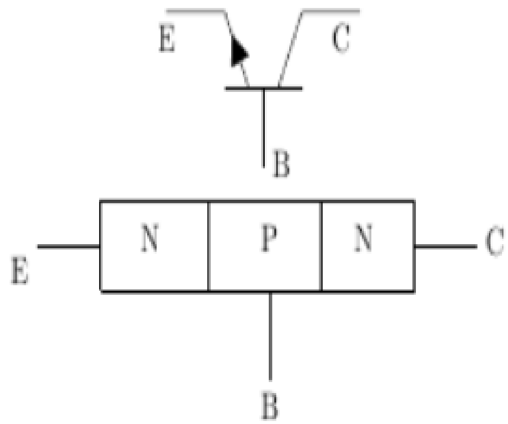
1. BJT Common Emitter Characteristics

i)Input characteristics:

Aim: To study input and output characteristics of a Bipolar junction transistor in Common-emitter configuration.



PNP Transistor



NPN Transistor

Emitter – The section that supplies the large section of majority charge carrier is called emitter. The emitter is always connected in forward biased with respect to the base so that it supplies the majority charge carrier to the base. The emitter-base junction injects a large amount of majority charge carrier into the base because it is heavily doped and moderate in size.

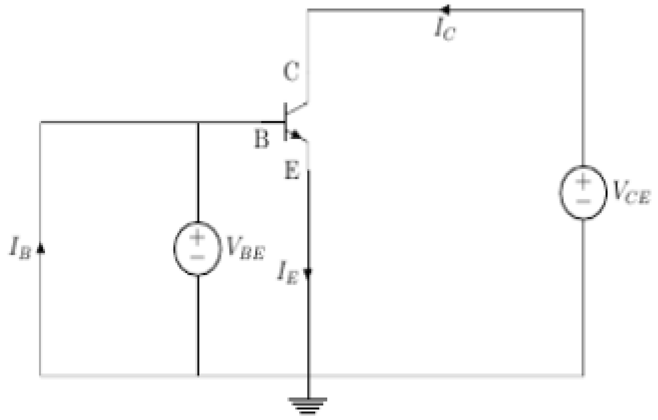
Collector – The section which collects the major portion of the majority charge carrier supplied by the emitter is called a collector. The collector-base junction is always in reverse bias. Its main function is to remove the majority charges from its junction with the base. The collector section of the transistor is moderately doped, but larger in size so that it can collect most of the charge carrier supplied by the emitter.

Base – The middle section of the transistor is known as the base. The base forms two circuits, the input circuit with the emitter and the output circuit with the collector. The emitter-base circuit is in forward biased and offered the low resistance to the circuit. The collector-base junction is in reverse bias and offers the higher resistance to the circuit. The base of the transistor is lightly doped and very thin due to which it offers the majority charge carrier to the base.

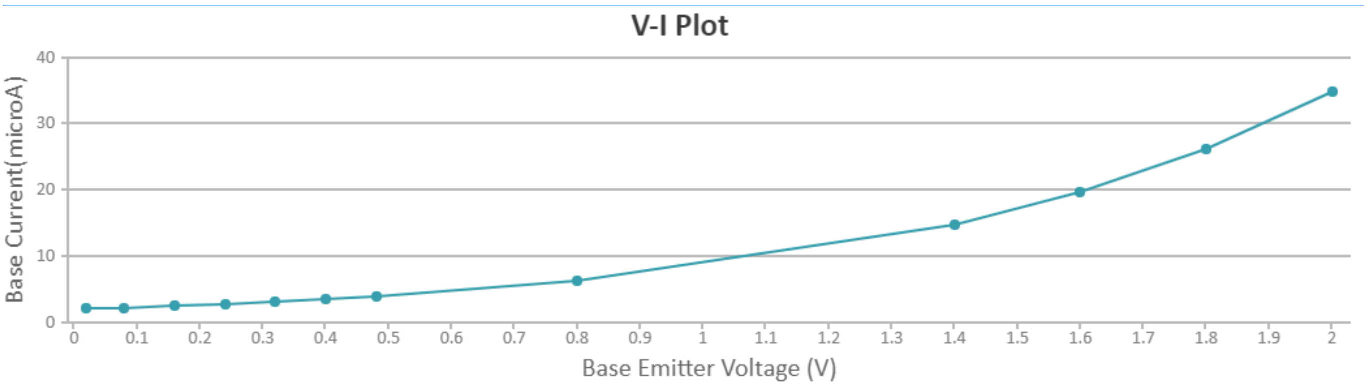
PROCEDURE:

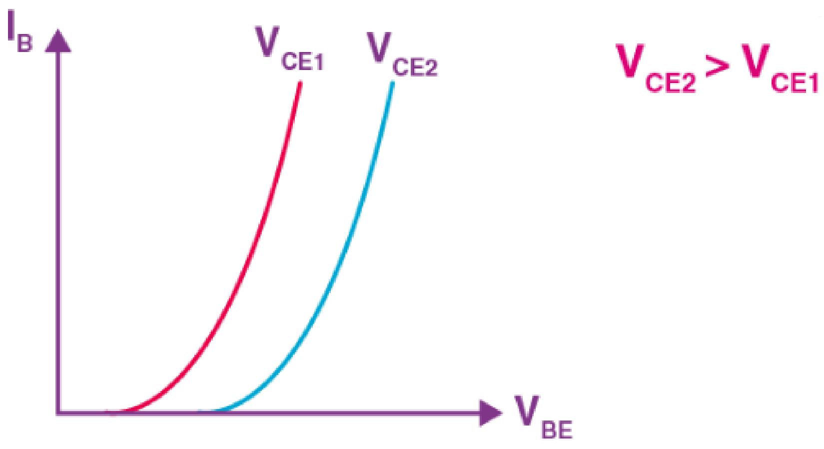
1. Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω
2. Set the Collector-Emitter Voltage(V_{CE}) to 1 V by adjusting the rheostat R_{h2}
3. Base Emitter Voltage (V_{BE}) is varied by adjusting the rheostat R_{h1}.
4. Note the reading of Base current (I_B) in micro Ampere.
5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with V_{BE} along X-axis and I_B along Y-axis.
6. Click on 'Clear' button to take another sets of readings
7. Now set the Collector-Emitter Voltage(V_{CE}) to 2 V, 3 V, 4 V

CIRCUIT:



RESULT:



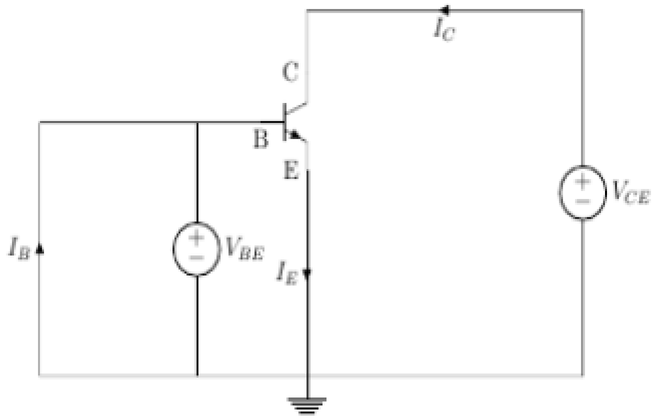


ii)Output characteristics:

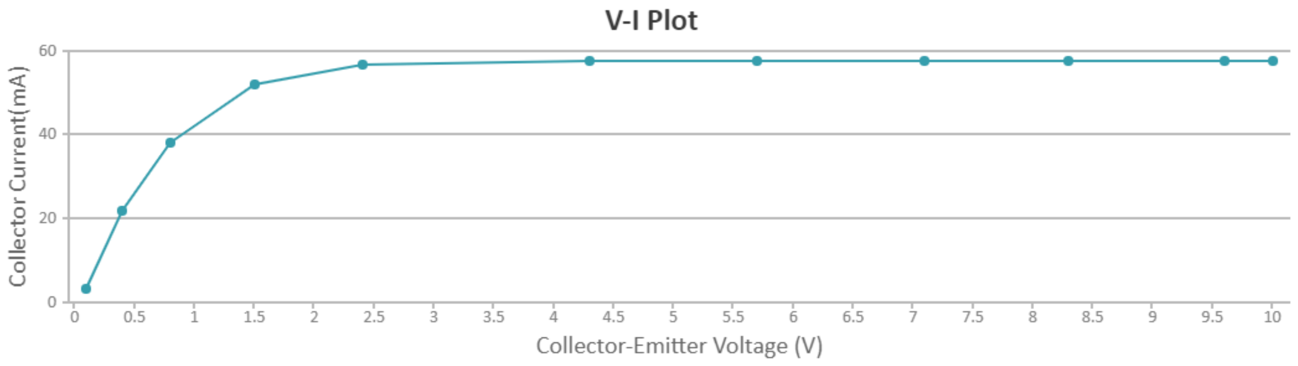
PROCEDURE:

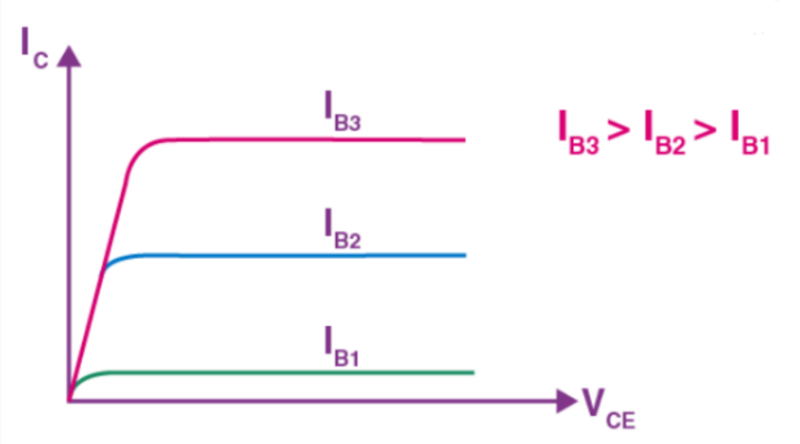
1. Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω
2. Set the Base current(I_B)15 uA by adjusting the rheostat R_{h1}
3. Vary the Collector-Emitter Voltage(V_{CE})is varied by adjusting the rheostat R_{h2}.
4. Note the reading of Collector current(I_C).
5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with V_{CE} along X-axis and I_C along Y-axis.
6. Click on 'Clear' button to take another sets of readings
7. Now set the Base Current(I_B) to 20 uA

CIRCUIT:



RESULT:





INFERENCE:

In this model, all the I-V curves start from $IC=0$ and $V_{CE}=V_{CE,\mathrm{sat}}$, called the saturation voltage. If $IB=0$, the curve is $IC=0$ for all $V_{CE}\geq V_{CE,\mathrm{sat}}$. If $IB>0$, then $I_C=\beta_{IB}$ for all $V_{CE}>V_{CE,\mathrm{sat}}$.

2. BJT Common Base Characteristics

i)Input characteristics:

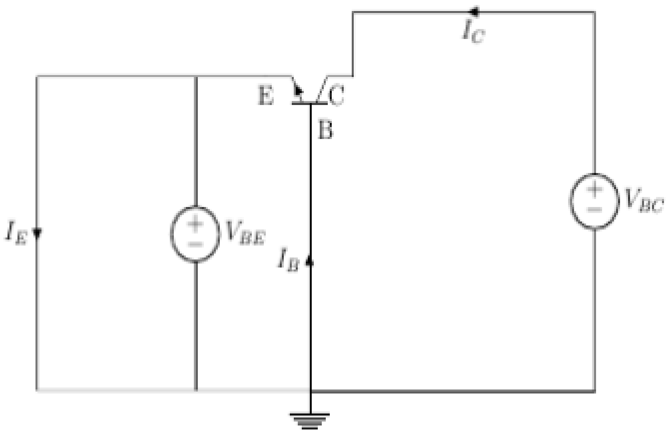
AIM:

To study input and output characteristics of a Bipolar junction transistor in Common-base configuration.

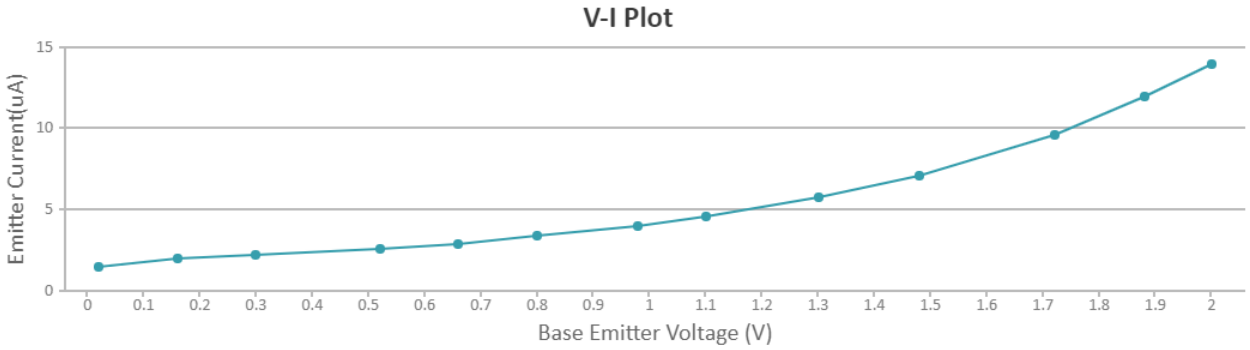
PROCEDURE:

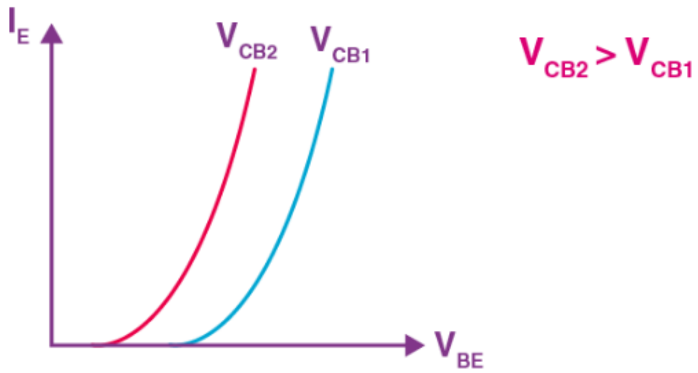
- Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω
- Set the Collector-Base Voltage(V_{CB}) to 1 V by adjusting the rheostat R_{h2}
- Base Emitter Voltage (V_{BE}) is varied by adjusting the rheostat R_{h1}.
- Note the reading of emitter current (I_E) in m Ampere.
- Click on 'Plot' to plot the I-V characteristics of Common-Base configuration. A graph is drawn with VBE along X-axis and IE along Y-axis.
- Click on 'Clear' button to take another sets of readings
- Now set the Collector-Emitter Voltage(V_{CB}) to 2 V, 3 V, 4 V

CIRCUIT:



RESULT:



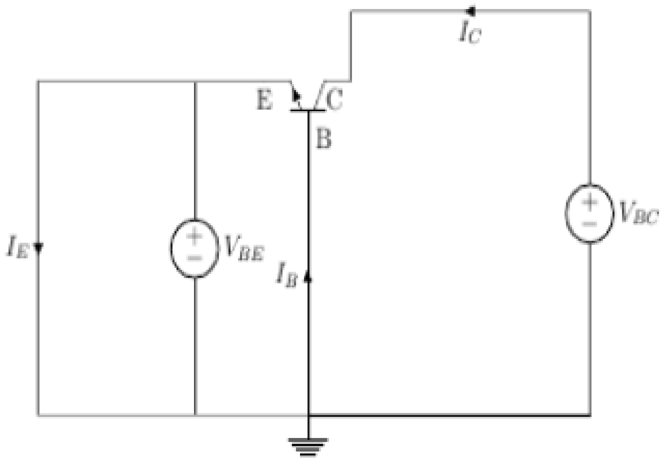


ii) Output characteristics:

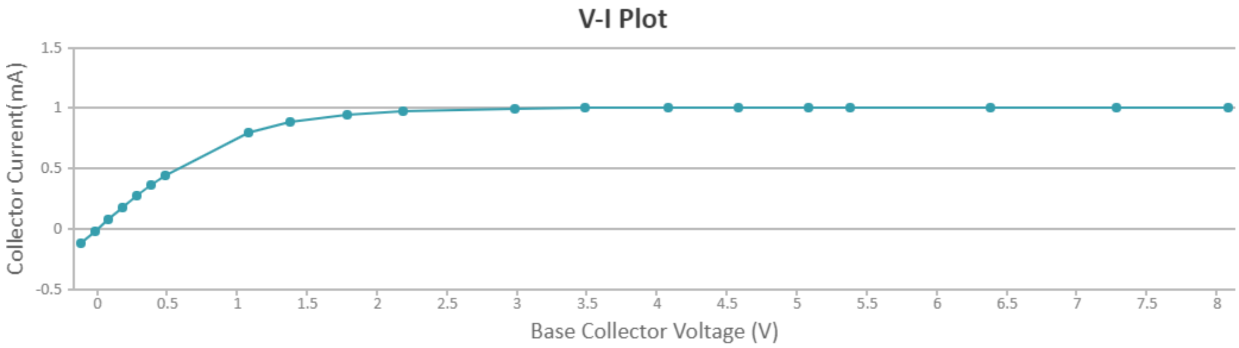
PROCEDURE:

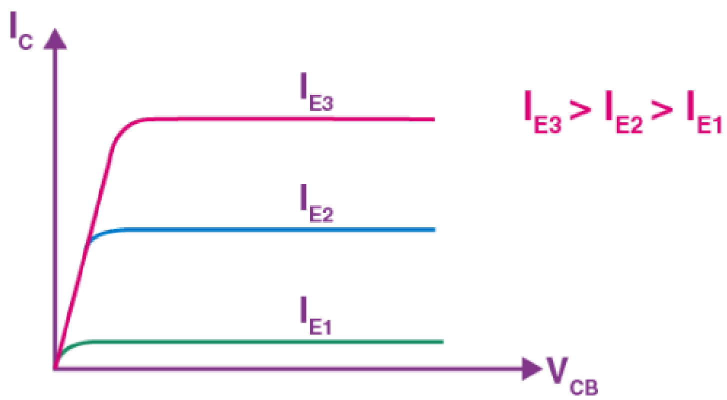
- Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω
- Set the Emitter current(I_E)1 mA by adjusting the rheostat R_{h1}
- Vary the Collector-Base Voltage (V_{CB}) is varied by adjusting the rheostat R_{h2}.
- Note the reading of Collector current(I_C).
- Click on 'Plot' to plot the I-V characteristics of Common-Base configuration. A graph is drawn with V_{CB} along X-axis and I_C along Y-axis.
- Click on 'Clear' button to take another sets of readings
- Now set the Emitter Current(I_E) to 2 mA

CIRCUIT:



RESULT:





INFERENCE:

At saturation region, both emitter-base junction J_E and collector-base junction J_C are forward biased. From the above graph, we can see that a sudden increase in the collector current when the output voltage V_{CB} makes the collector-base junction J_C forward biased.

3a. HALF WAVE RECTIFIER

AIM:

To understand the working of the Half Wave Rectifier Circuit.

THEORY:

The rectifier circuit that converts alternating current into the direct current in alternate half cycles is known as a halfwave rectifier circuit. The half-wave rectifier passes only one half of the input sine wave and rejects the other half.

PROCEDURE:

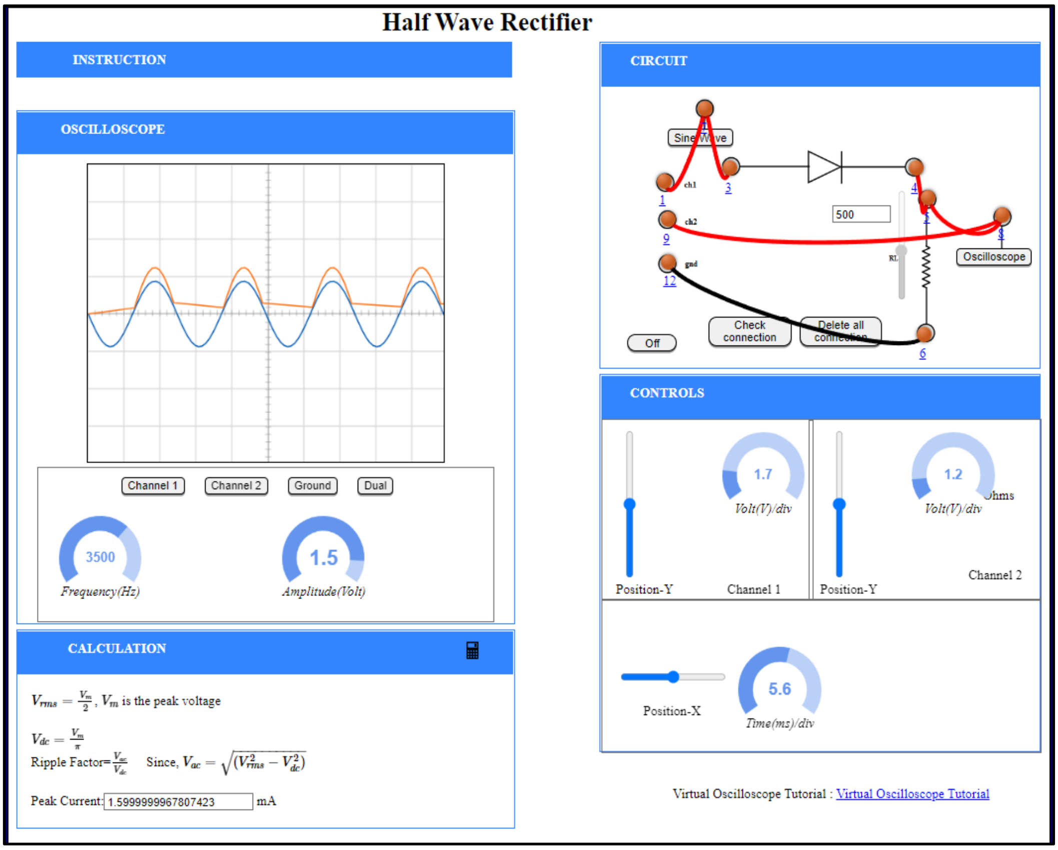
- Make the required connections as stated in the instructions tab.
- Click- Check connection to make sure that the connections are right and you

can move on with the experiment. Set load resistance to 500Ω.

- Click- On. Then Click- Sine wave to form a sinusoidal graph.
- Click- Oscilloscope to get the rectified output. Adjust amplitude and frequency as per convenience.

INFERENCE:

The working of a Half-Wave Rectifier was understood.



3b. FULL WAVE RECTIFIER:

AIM:

To know the working of the Full Wave Rectifier Circuit.

THEORY:

The Full Wave Rectifier Circuit is a circuit that converts AC to DC. It consists of 2 diodes connected to a single load resistance. No part of the input waveform is rejected.

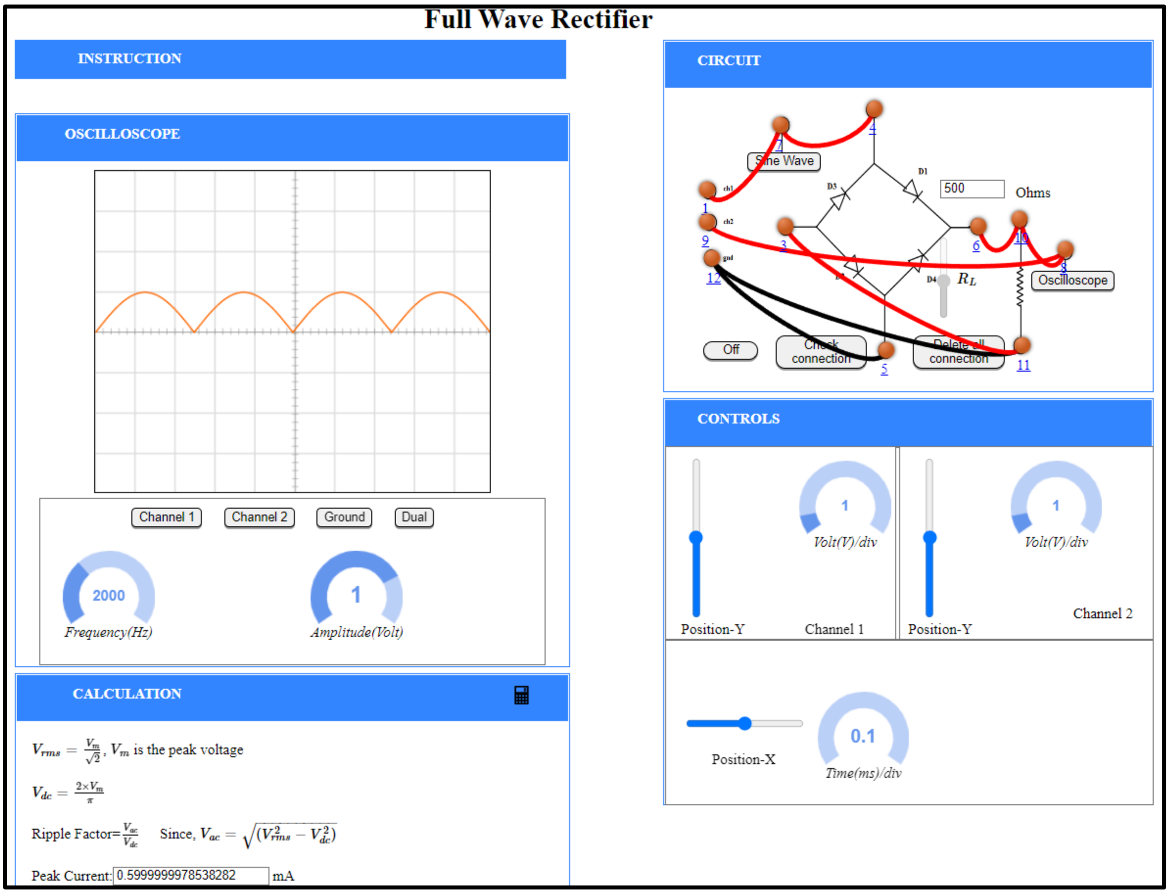
PROCEDURE:

• Make the necessary connection throughout the circuit as per the instructions tab.

• Click- Check connection to make sure that the connections are right to move on with the experiment. Set load resistance to 500Ω.

• Click- On to turn on the circuit. Then Click- Sine wave to form a sinusoidal wave form.

• Click- Oscilloscope to get the rectified output. Adjust the amplitude and frequency as per requirement.

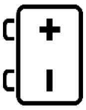


4a. VERIFICATION OF LOGIC GATES

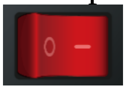
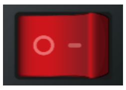
AIM:

Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates.

- **AND GATE:**

Step-1) Connect the supply (+5V)  to the circuit.

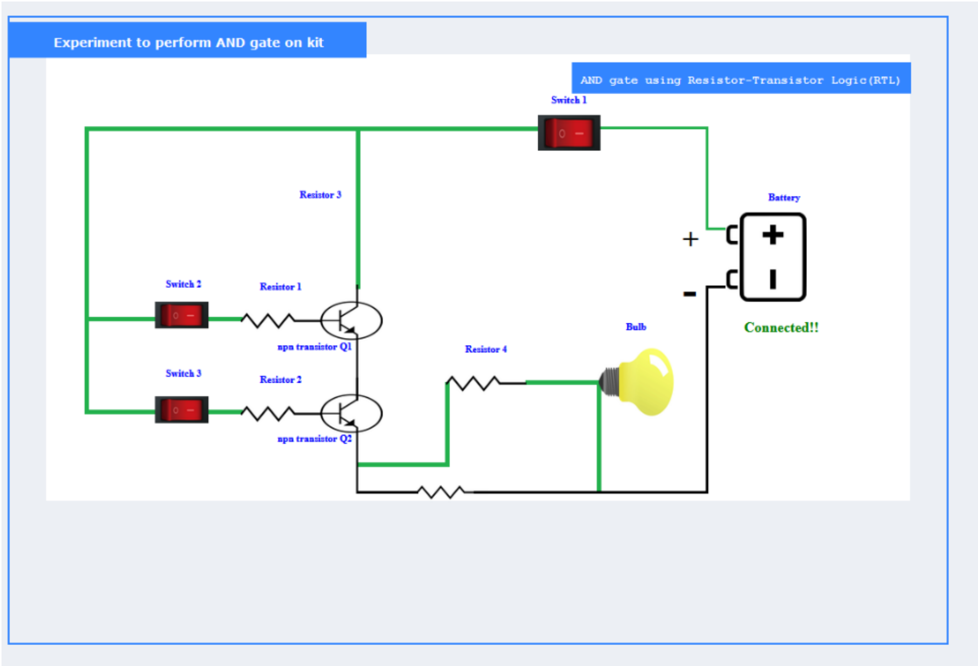
Step-2) Press the switches for inputs "A" and "B".

The switch in ON state is  and the switch in OFF state is 

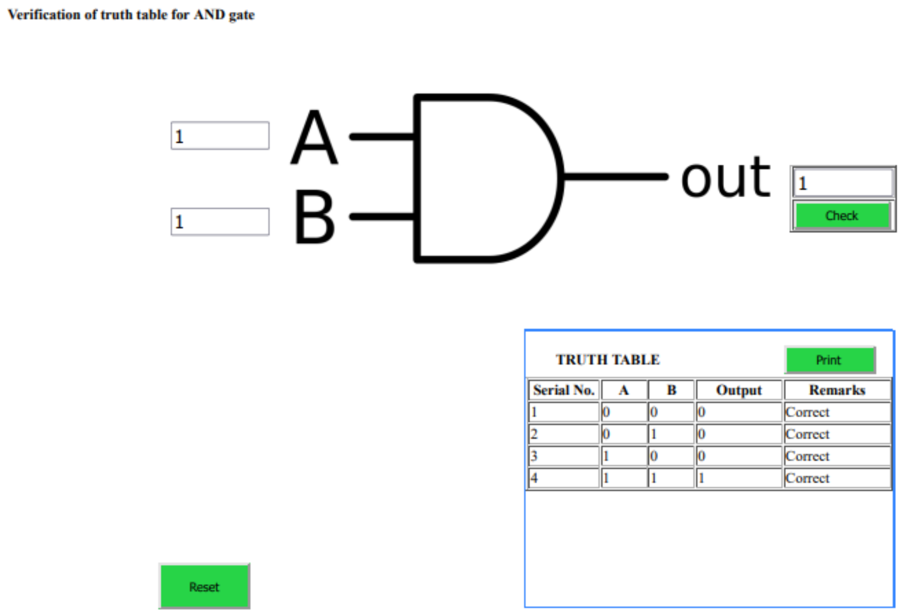
Step-3) The bulb glows if both the switches are OFF else it won't glow.

The bulb in OFF state is  and the bulb in ON state is  .

Step-4) Repeat step-2 and step-3 for all state of inputs.

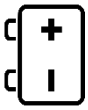


Verification of truth table for AND gate

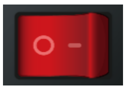


Serial No.	A	B	Output	Remarks
1	0	0	0	Correct
2	0	1	0	Correct
3	1	0	0	Correct
4	1	1	1	Correct

- **<u>OR Gate:</u>**

Step-1) Connect the supply (+5V)  to the circuit.

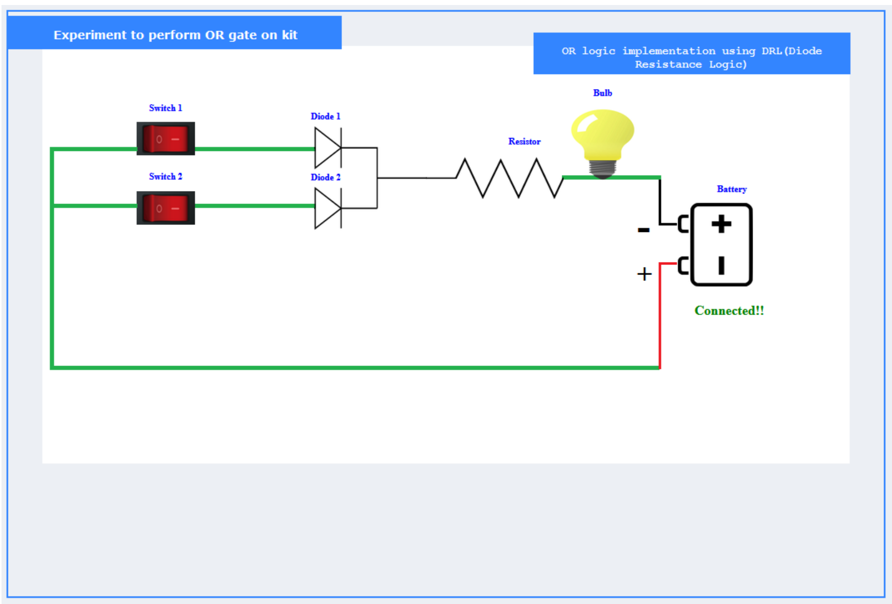
Step-2) Press the switches for inputs "A" and "B".

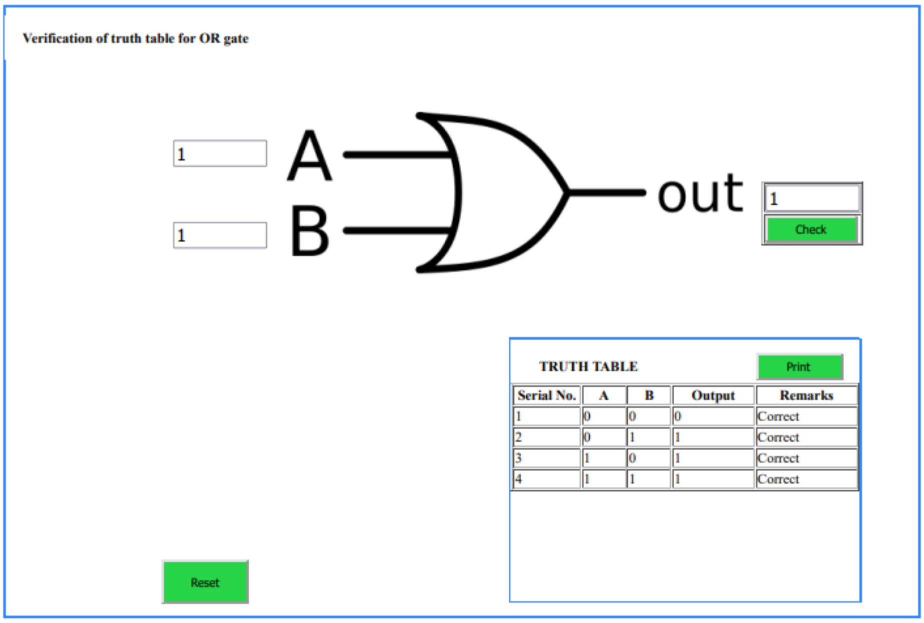
The switch in ON state is  and the switch in OFF state is 

Step-3) The bulb glows if any one or both the switches are ON else it won't glow.

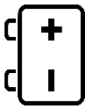
The bulb in OFF state is  and the bulb in ON state is  .

Step-4) Repeat step-2 and step-3 for all state of inputs.



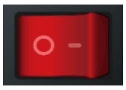


- **<u>NOT gate:</u>**

Step-1) Connect the supply (+5V)  to the circuit.

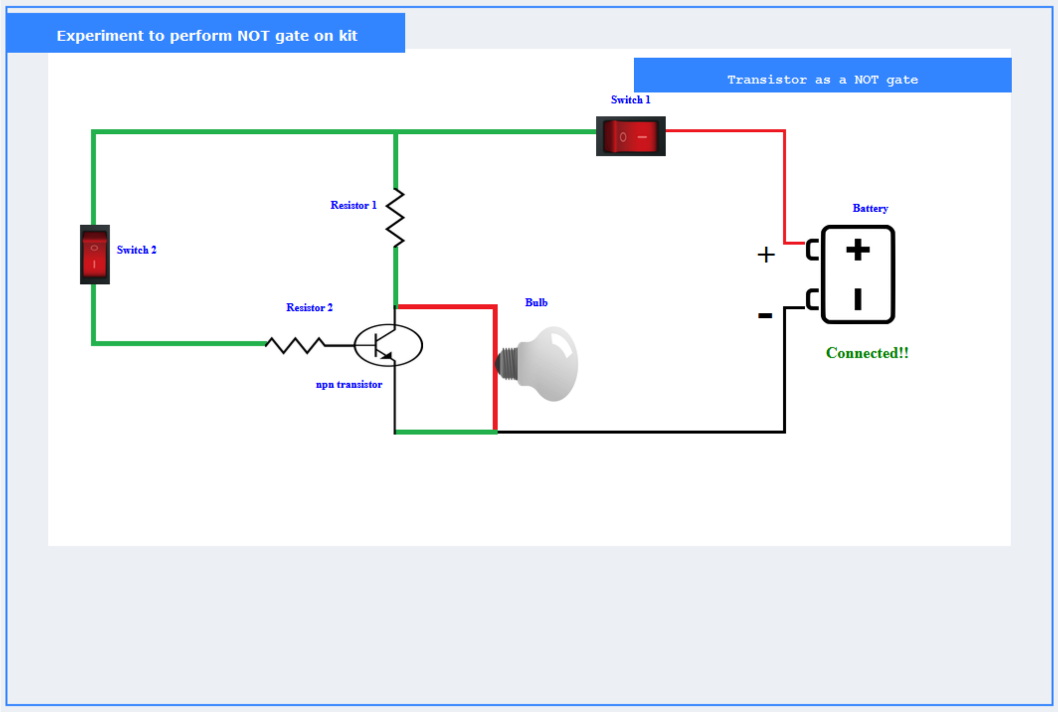
Step-2) Press the switch 1 to connect battery to the circuit.

Step-3) Press the switch 2 for input “A”.

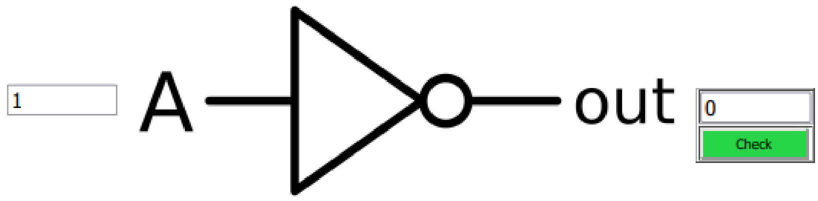
The switch in ON state is  and the switch in OFF state is 

Step-4) The bulb glows if switch 2 is OFF else it won't glow.

The bulb in OFF state is  and the bulb in ON state is  .



Verification of truth table for NOT gate

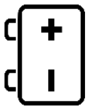


TRUTH TABLE Print

Serial No.	A	Output	Remarks
1	0	1	Correct
2	1	0	Correct

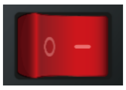
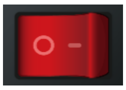
Reset

- **NAND gate**

Step-1) Connect the supply (+5V)  to the circuit.

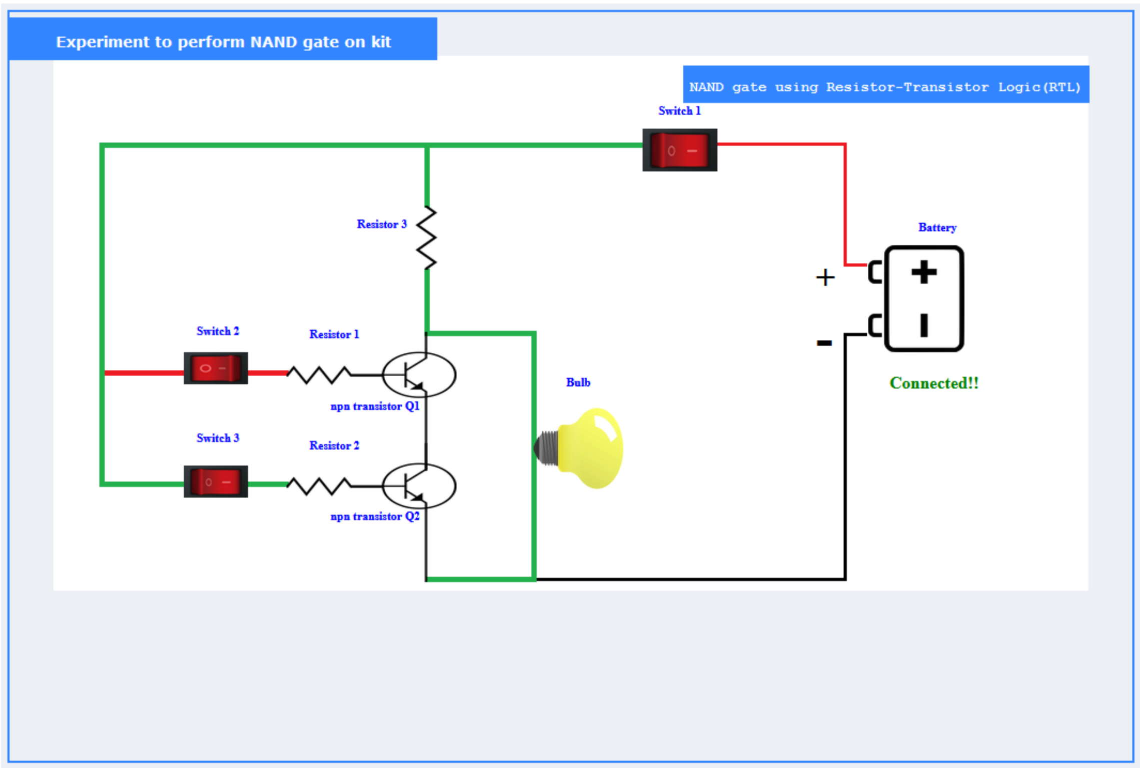
Step-2) Press the switch 1 to connect battery to the circuit.

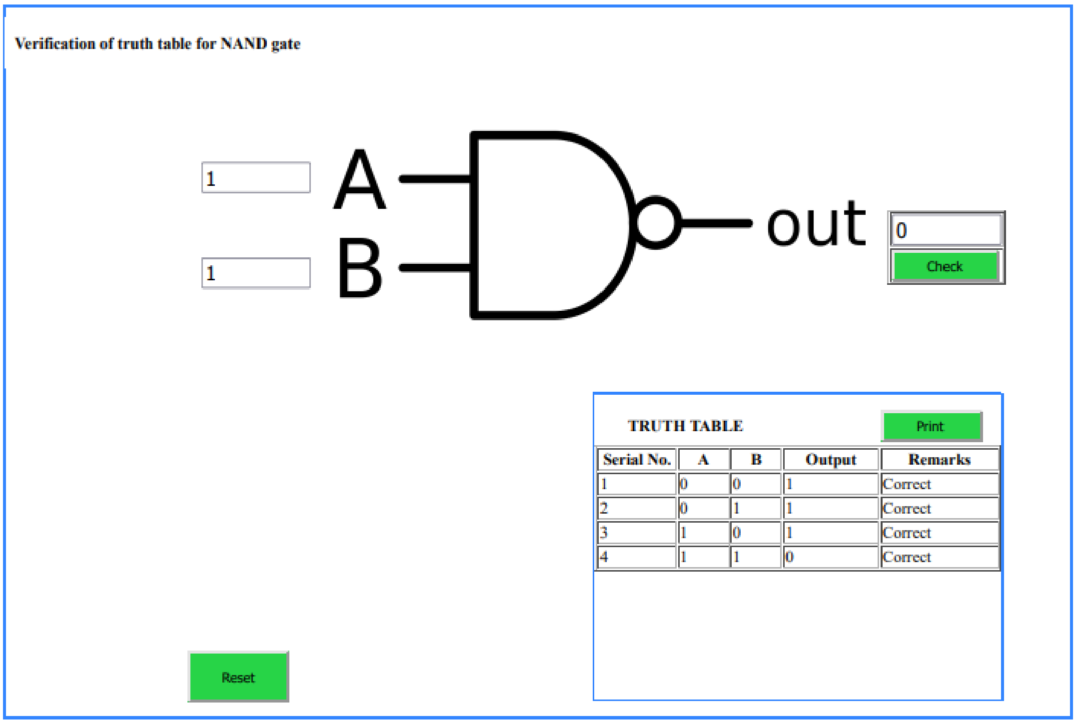
Step-3) Press the switches 2 and 3 for inputs "A" and "B".

The switch in ON state is  and the switch in OFF state is 

Step-4) The bulb glows if any one or both the switches are OFF else it won't glow.

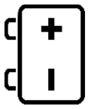
The bulb in OFF state is  and the bulb in ON state is  .





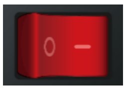
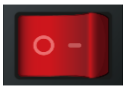
Serial No.	A	B	Output	Remarks
1	0	0	1	Correct
2	0	1	1	Correct
3	1	0	1	Correct
4	1	1	0	Correct

- **<u>NOR gate</u>**

Step-1) Connect the supply (+5V)  to the circuit.

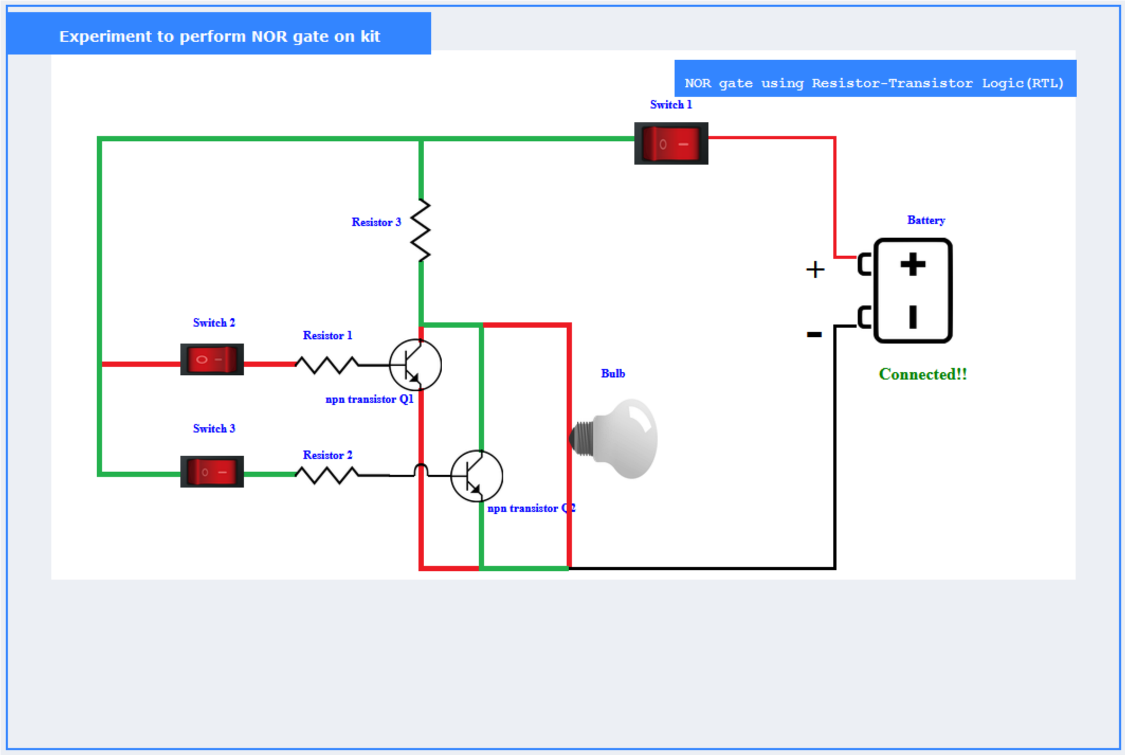
Step-2) Press the switch 1 to connect battery to the circuit.

Step-3) Press the switches 2 and 3 for inputs "A" and "B".

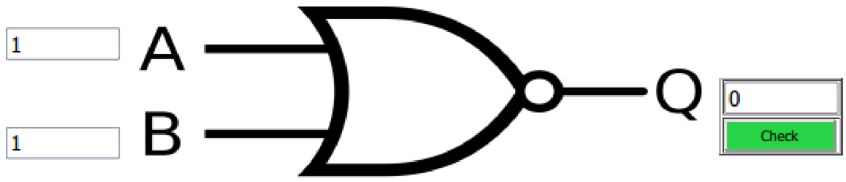
The switch in ON state is  and the switch in OFF state is 

Step-4) The bulb glows if both the switches are OFF else it won't glow.

The bulb in OFF state is  and the bulb in ON state is  .



Verification of truth table for NOR gate



TRUTH TABLE Print

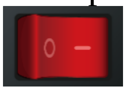
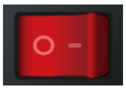
Serial No.	A	B	Output	Remarks
1	0	0	1	Correct
2	0	1	0	Correct
3	1	0	0	Correct
4	1	1	0	Correct

Reset

- **Ex-OR gate**

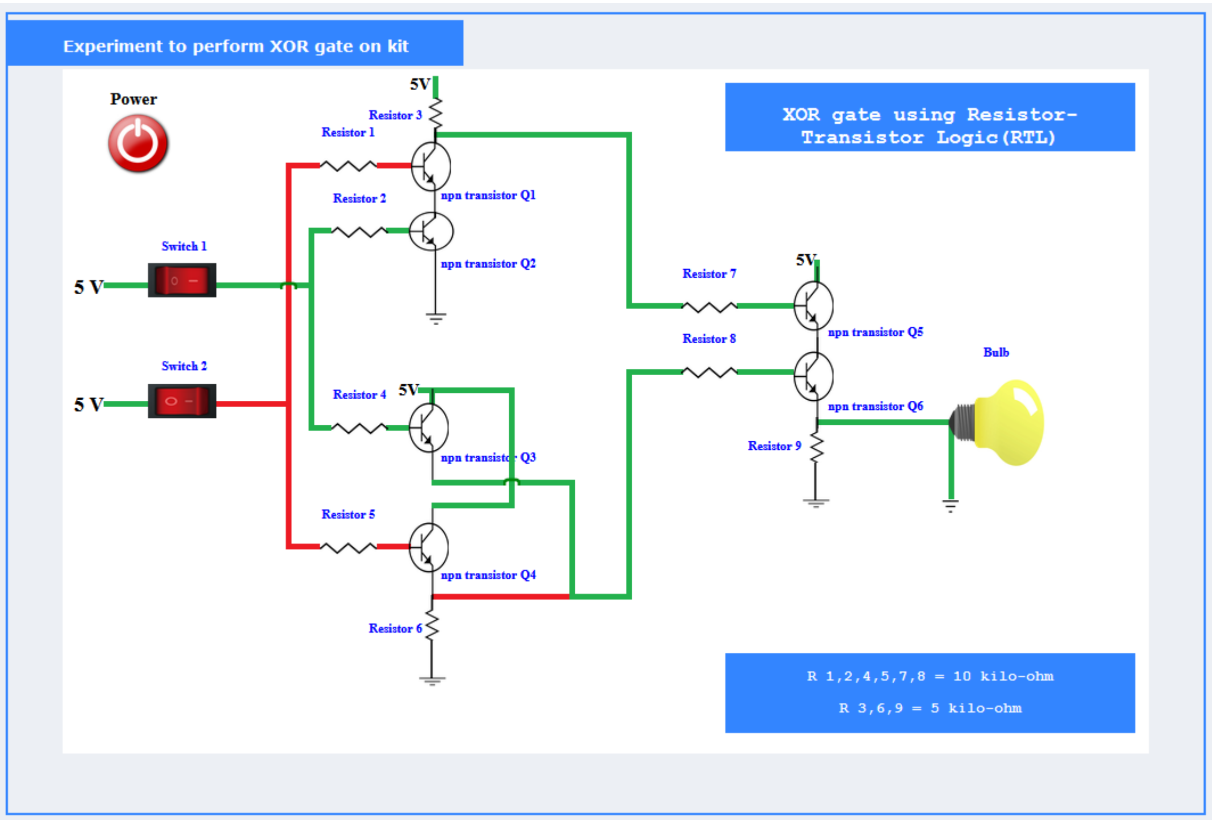
Step-1) Connect the supply (+5V)  to the circuit .

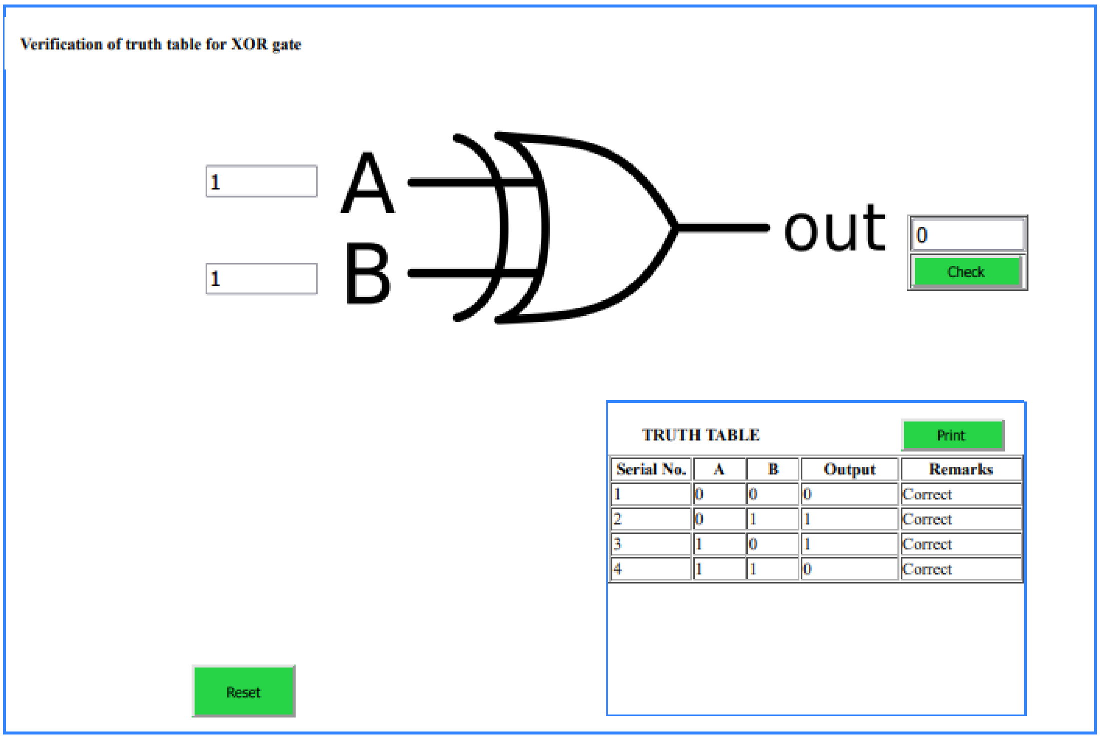
Step-2) Press the switches for inputs "A" and "B".

The switch in ON state is  and the switch in OFF state is 

Step-3) The bulb glows if one of the switches is ON and one of the switches is OFF else it won't glow.

The bulb in OFF state is  and the bulb in ON state is  .



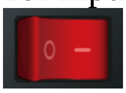
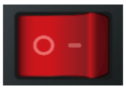


Serial No.	A	B	Output	Remarks
1	0	0	0	Correct
2	0	1	1	Correct
3	1	0	1	Correct
4	1	1	0	Correct

- **<u>Ex-NOR gate</u>**

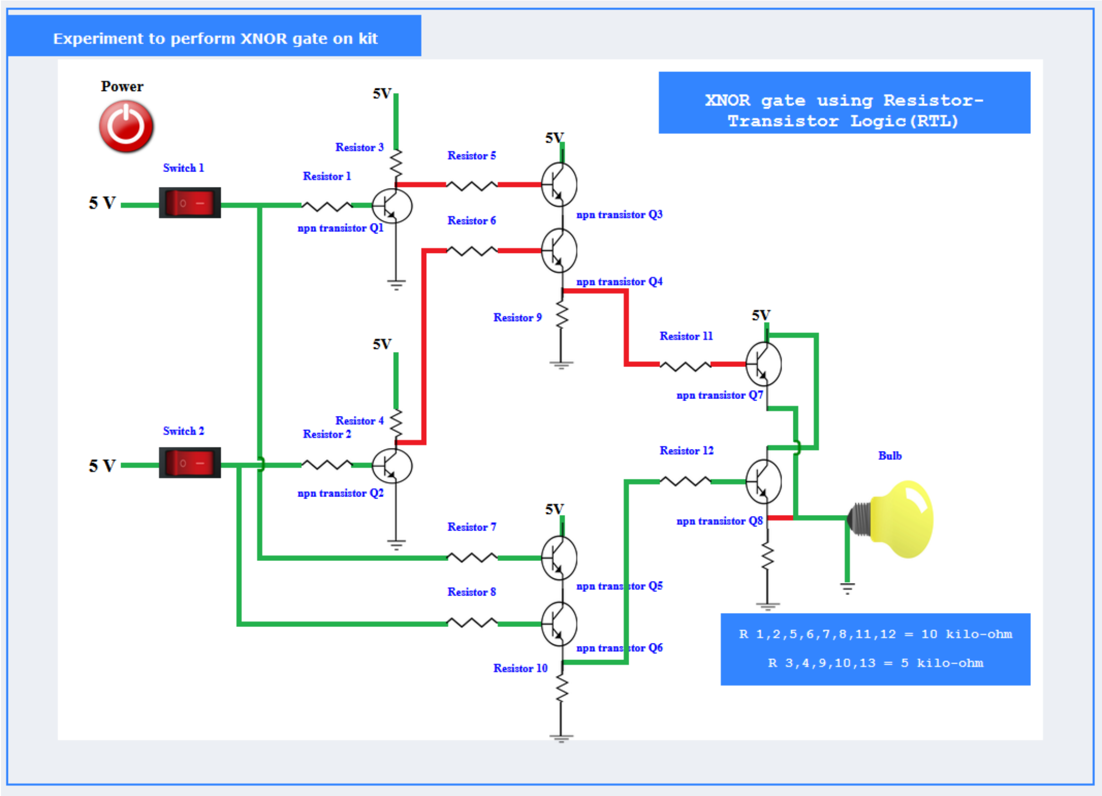
Step-1) Connect the supply (+5V)  to the circuit .

Step-2) Press the switches for inputs "A" and "B".

The switch in ON state is  and the switch in OFF state is 

Step-3) The bulb glows if both the switches are ON or if both the switches are OFF else it won't glow.

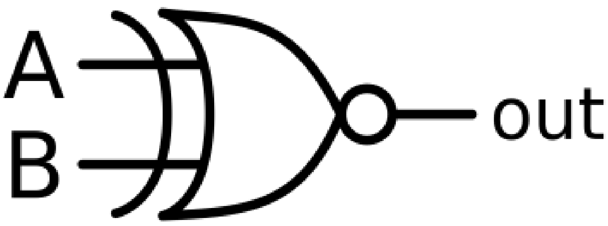
The bulb in OFF state is  and the bulb in ON state is  .



Verification of truth table for XNOR gate

1

1



1

Check

TRUTH TABLE Print

Serial No.	A	B	Output	Remarks
1	0	0	1	Correct
2	0	1	0	Correct
3	1	0	0	Correct
4	1	1	1	Correct

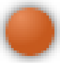
Reset

4b. REALIZATION OF LOGIC GATES USING UNIVERSAL NAND AND NOR GATES

AIM:

Realization of logic gates using universal NAND and NOR gates

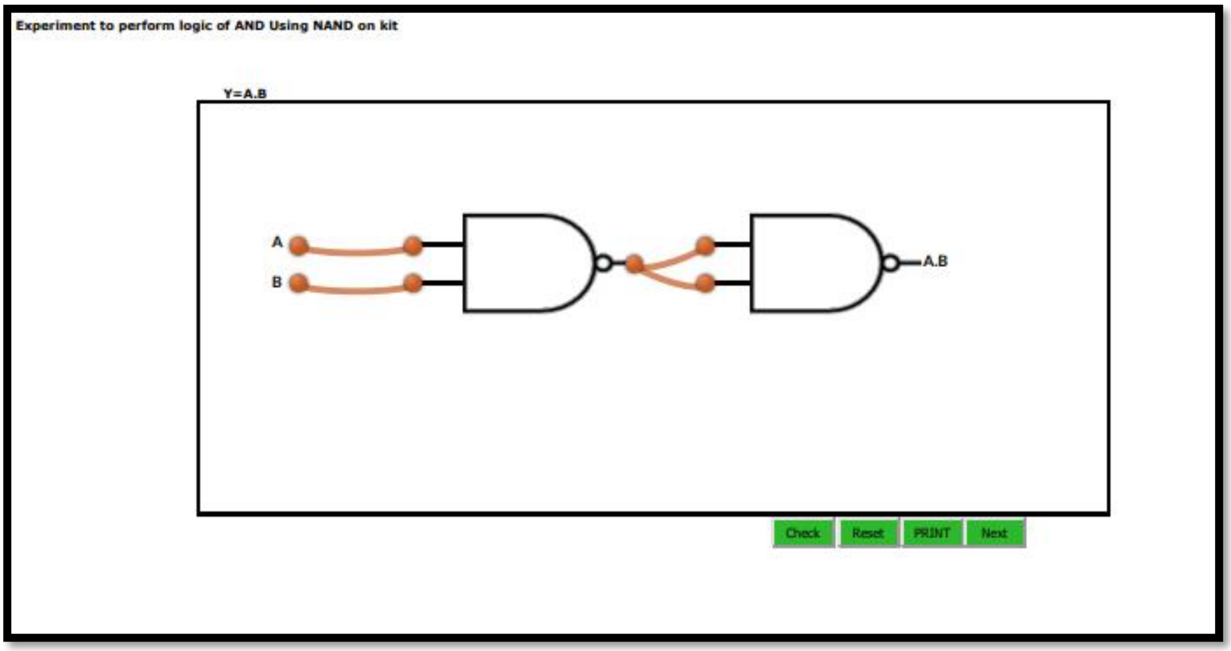
PROCEDURE:

Step-1) Select and drag "  " for generate wire of the circuit.

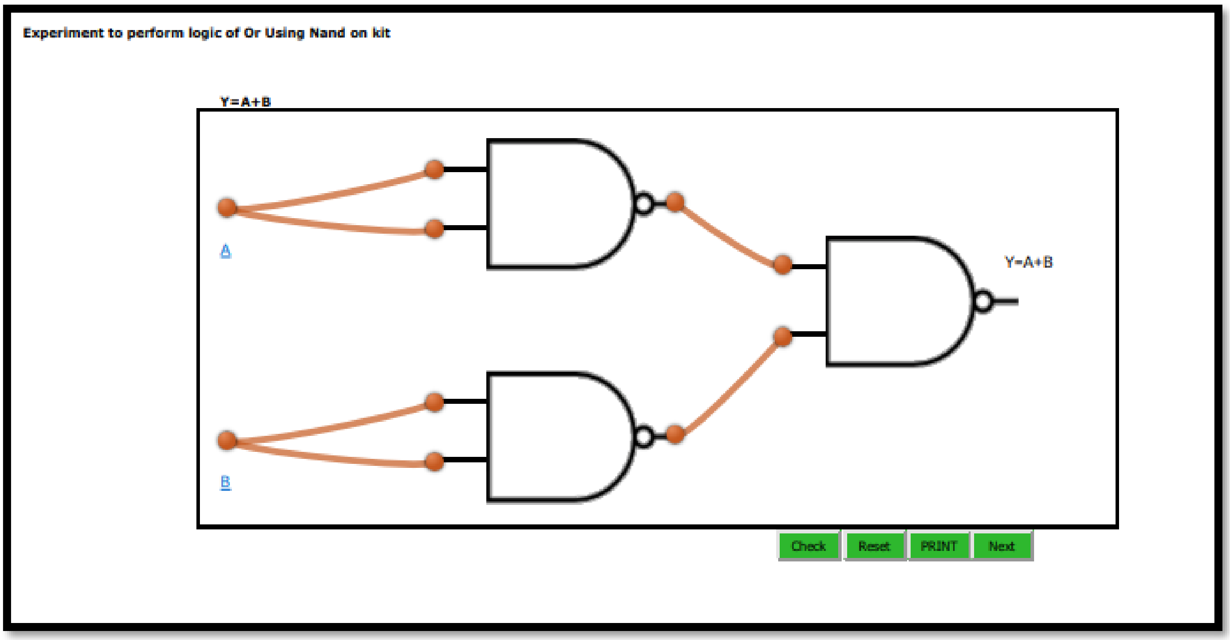
Step-2) Join the wire to perform the require logic.

Universality of NAND

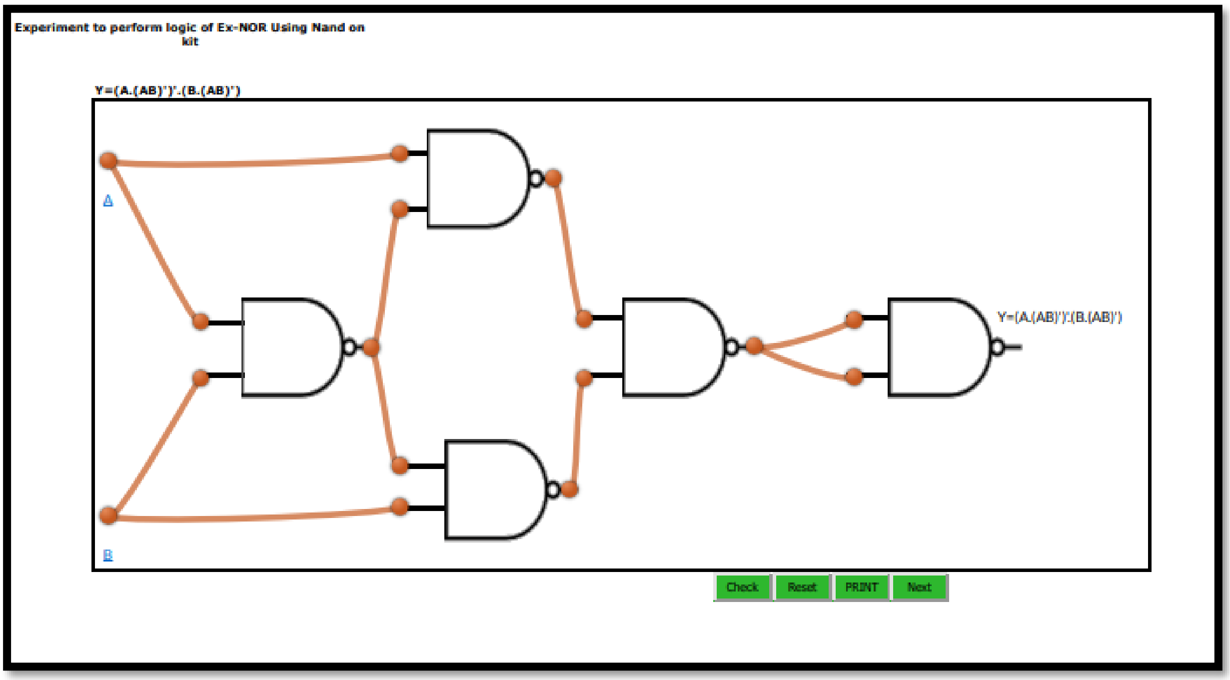
- NAND as AND



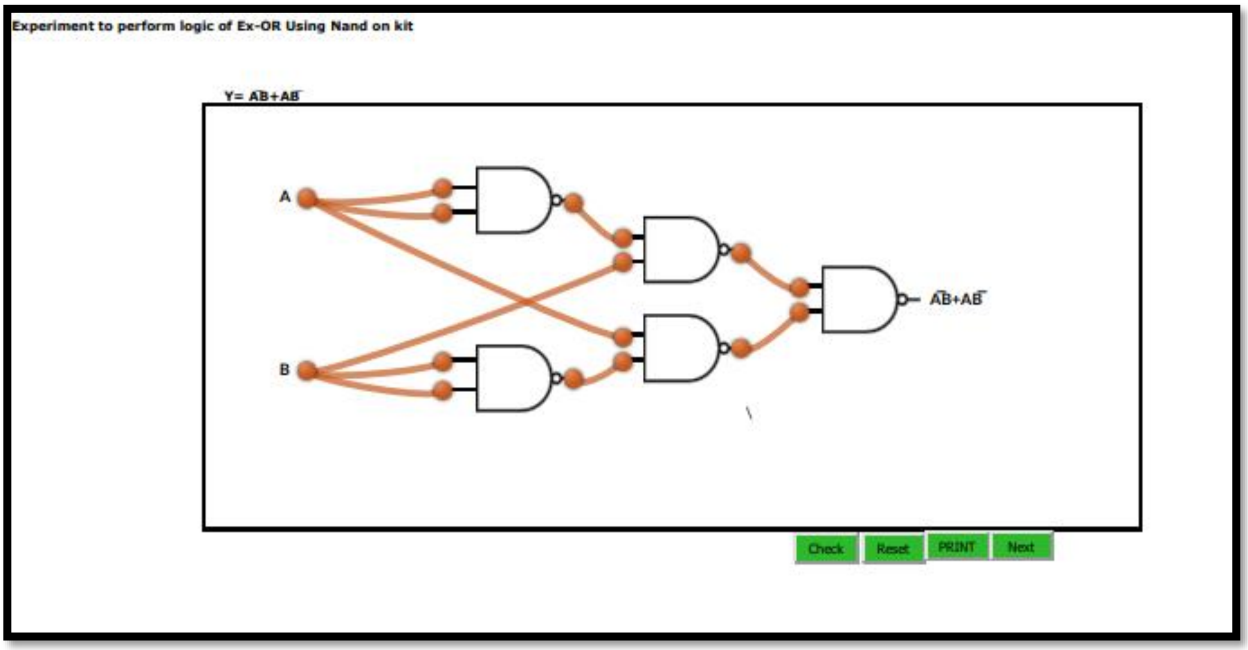
- NAND as OR



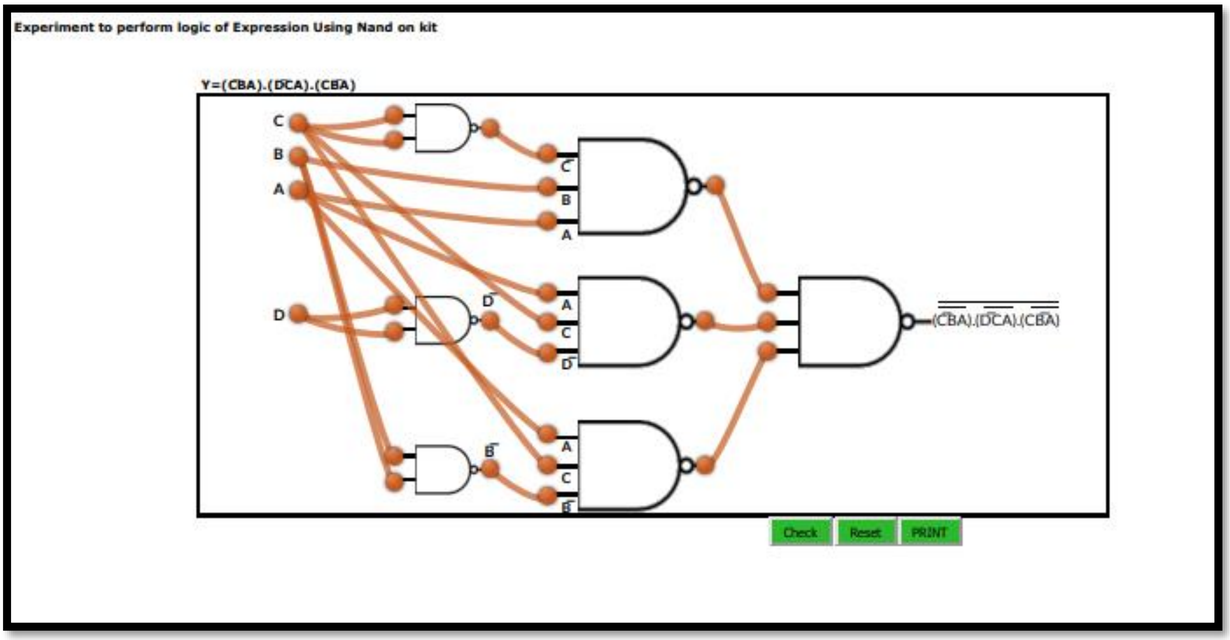
- NAND as Ex - NOR



- <u>NAND as Ex – OR</u>

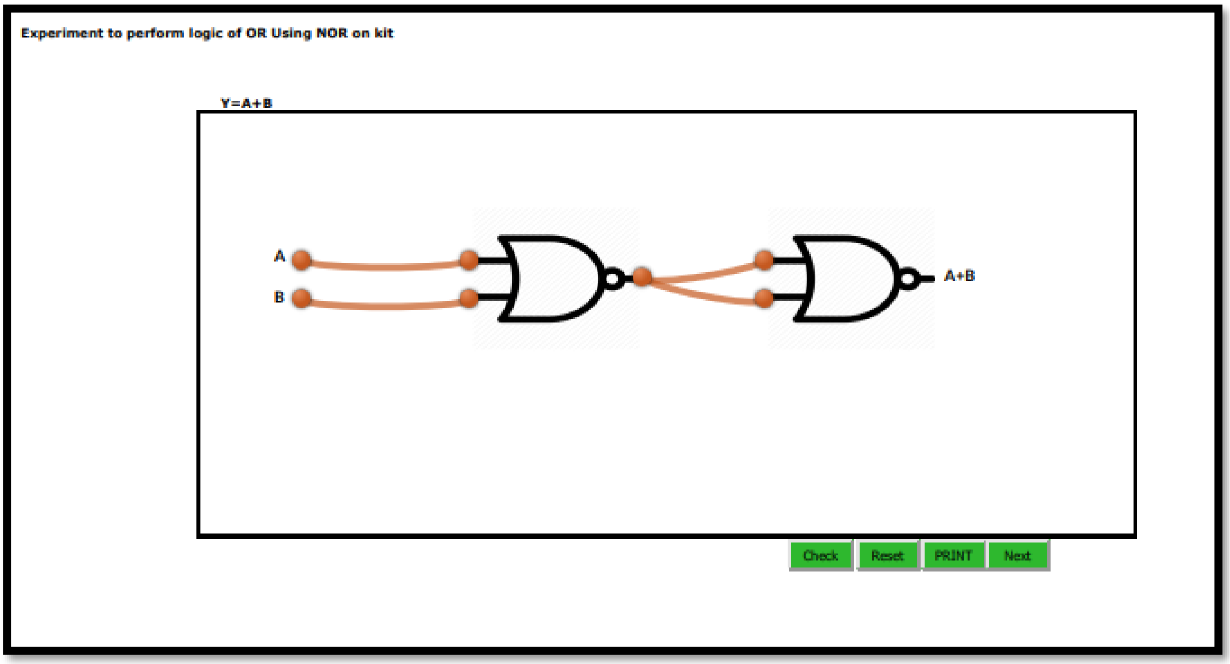


- <u>Solving logical expressions using NAND gate</u>

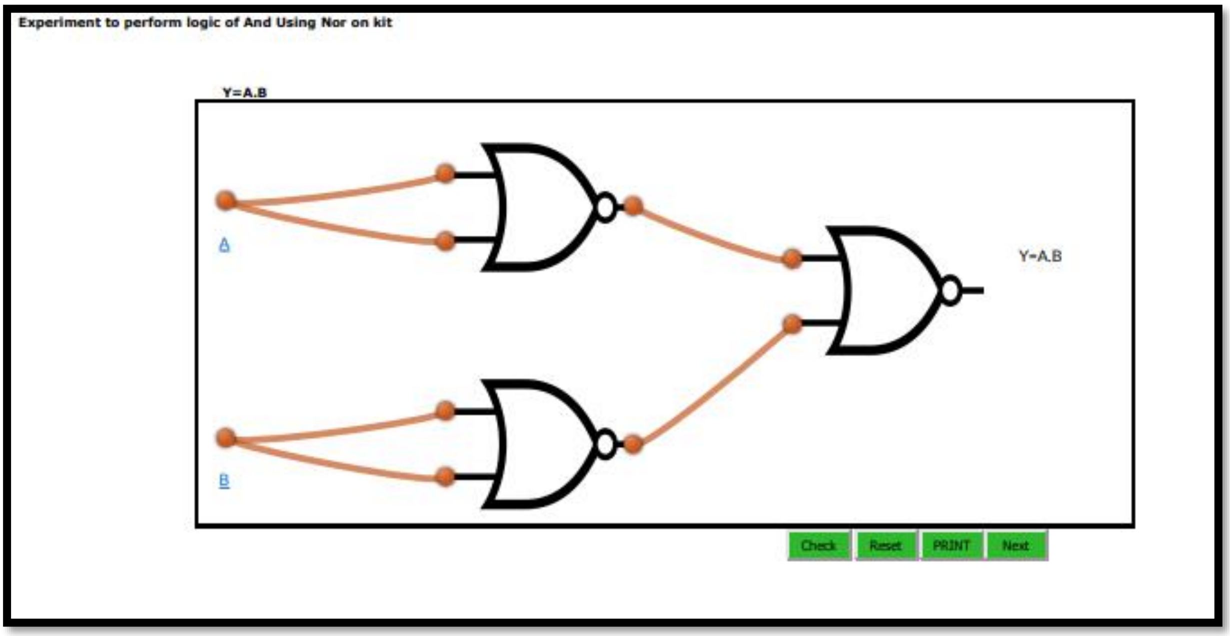


Universality of NOR

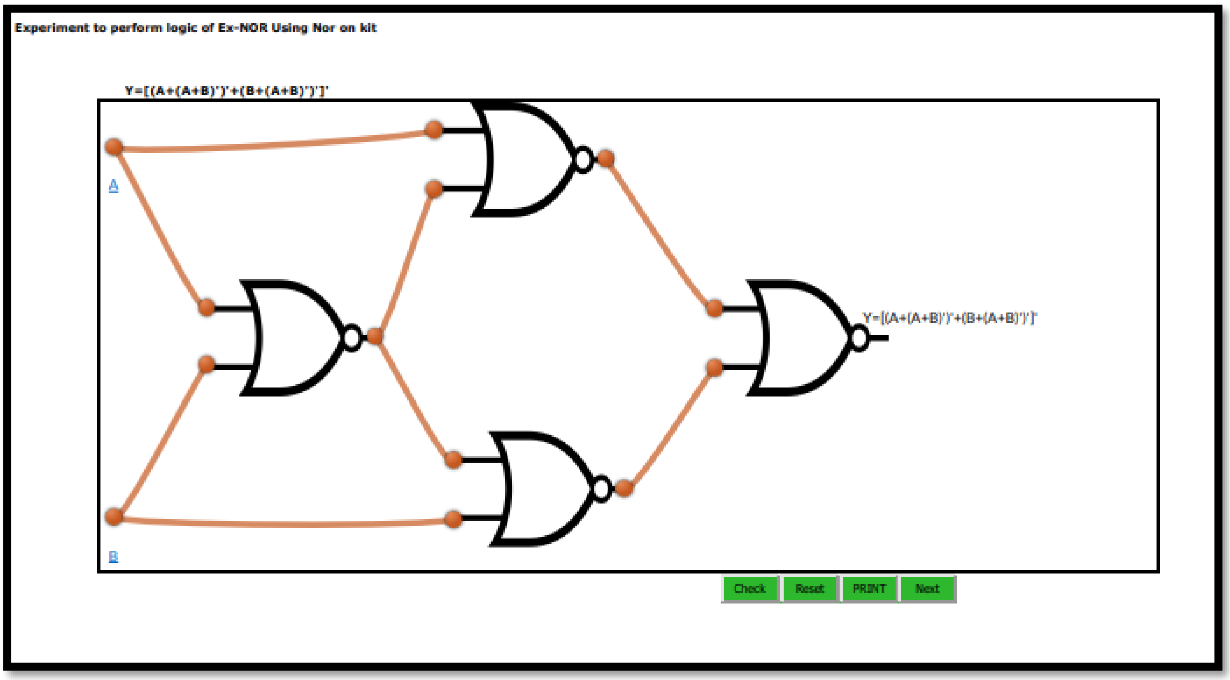
- NOR as OR



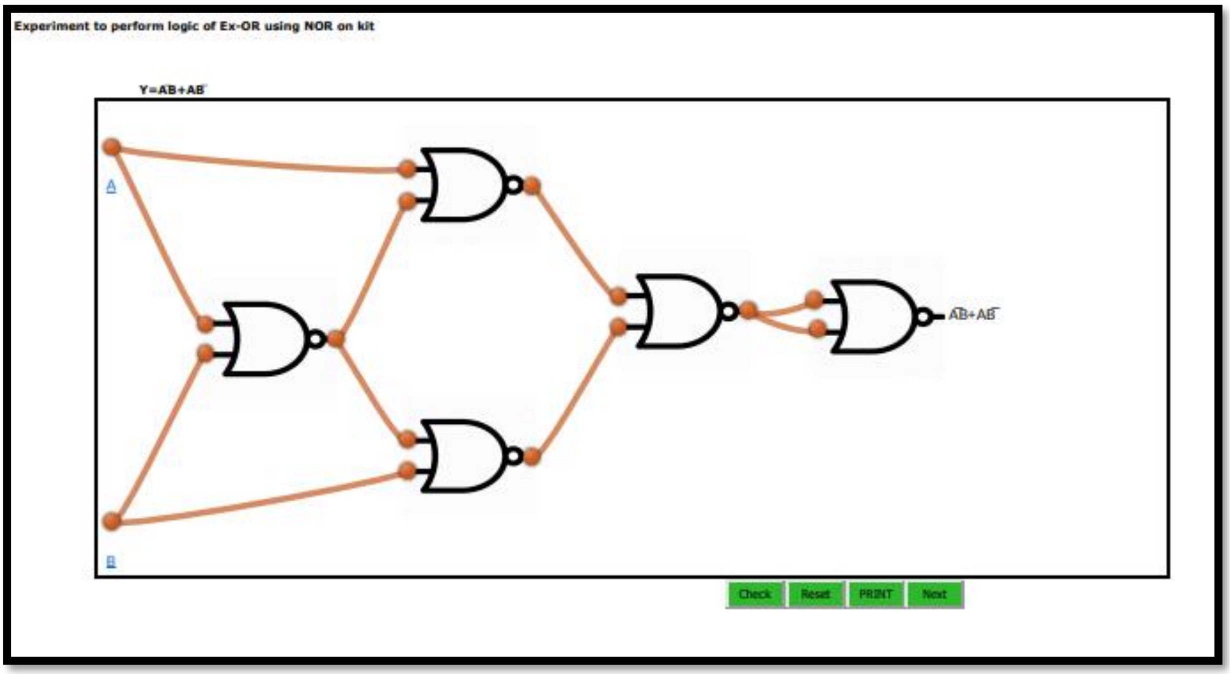
- NOR as AND



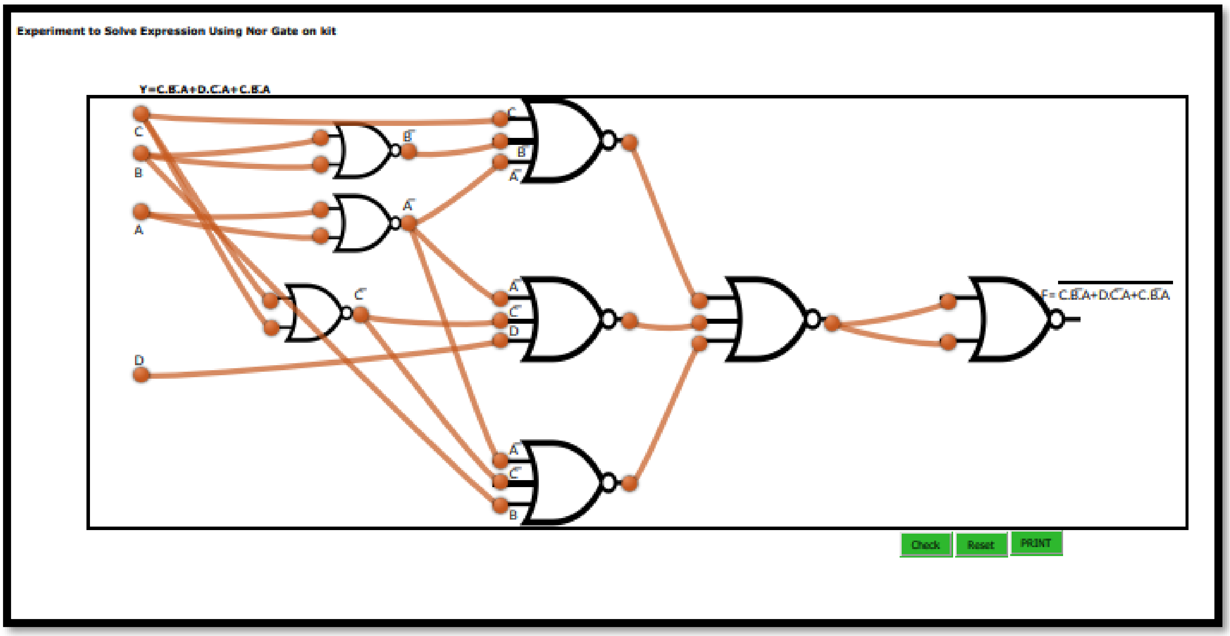
- <u>NOR as Ex – NOR</u>



- <u>NOR as Ex – OR</u>



- <u>Solving logical expressions using NOR gate</u>



INFERENCE:

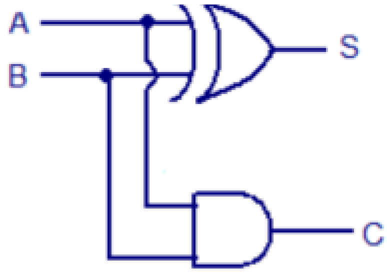
Logic Gates were realized using the universal NAND and NOR Gates.

5. VERIFICATION OF HALF ADDER AND FULL ADDER

AIM:

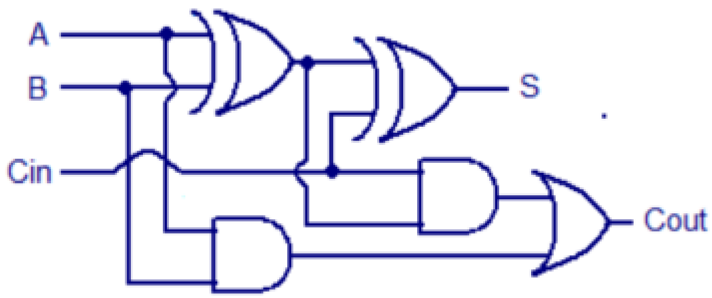
To understand the working of Half Adder and Full Adder respectively.

Half adder is a combinational arithmetic circuit that adds two numbers and produces a sum bit (S) and carry bit (C) as the output. If A and B are the input bits, then sum bit (S) is the X-OR of A and B and the carry bit (C) will be the AND of A and B.



Half adder

Full adder is a logic circuit that adds two input operand bits plus a Carry in bit and outputs a Carry out bit and a sum bit. The Sum out (S_{out}) of a full adder is the XOR of input operand bits A, B and the Carry in (C_{in}) bit.



Full adder

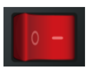
PROCEDURE:

1. Connect the supply (+5V) to the IC.

2. Press the switches for inputs "A" and "B".

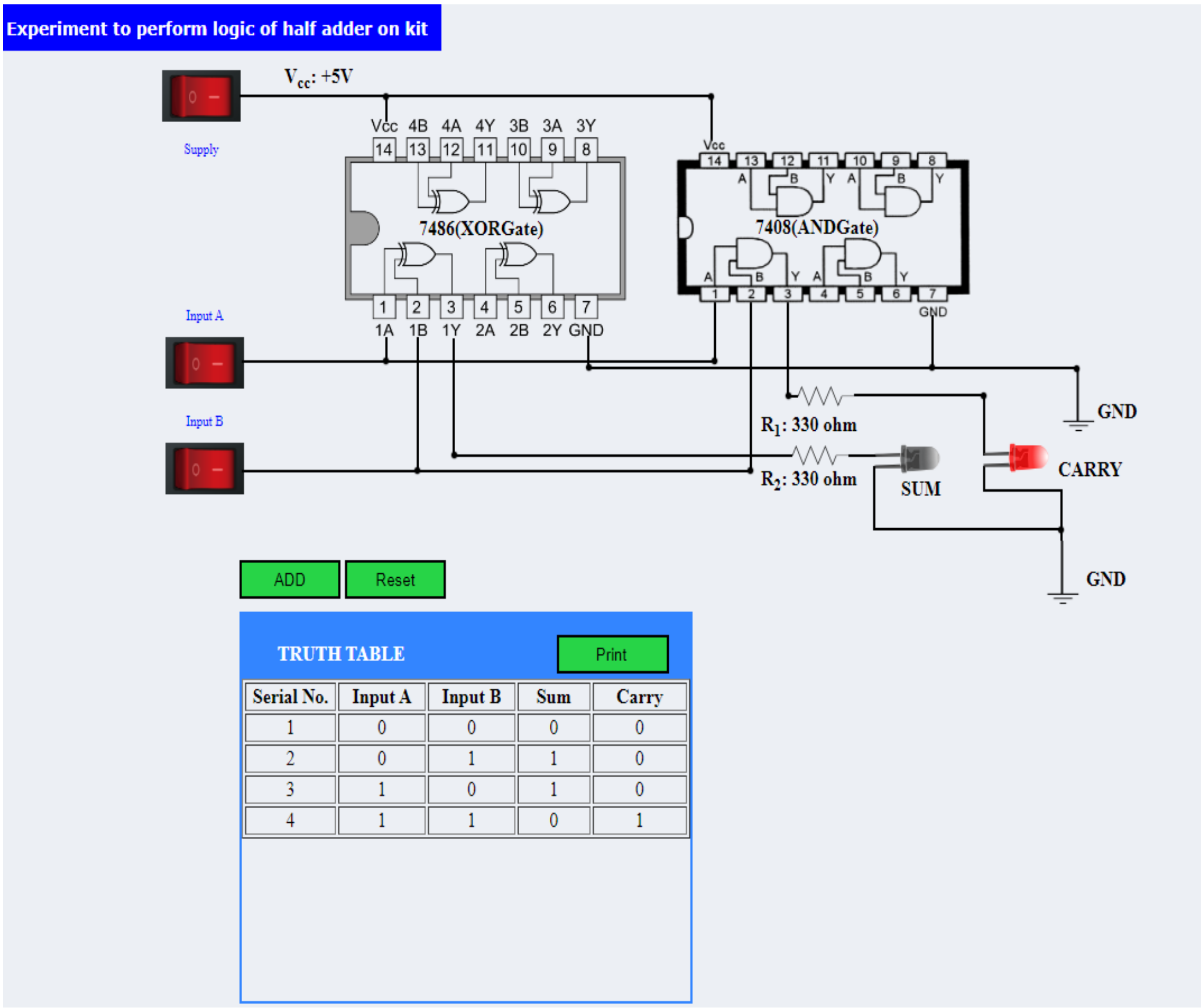
The switch in ON state is  and the switch in OFF state is 

3. The SUM LED glows if any one switch is ON out of both the switches else it won't glow.

And the CARRY LED glows if the both switch's state is  else it will remains OFF in other 3 states.

a) Half adder:

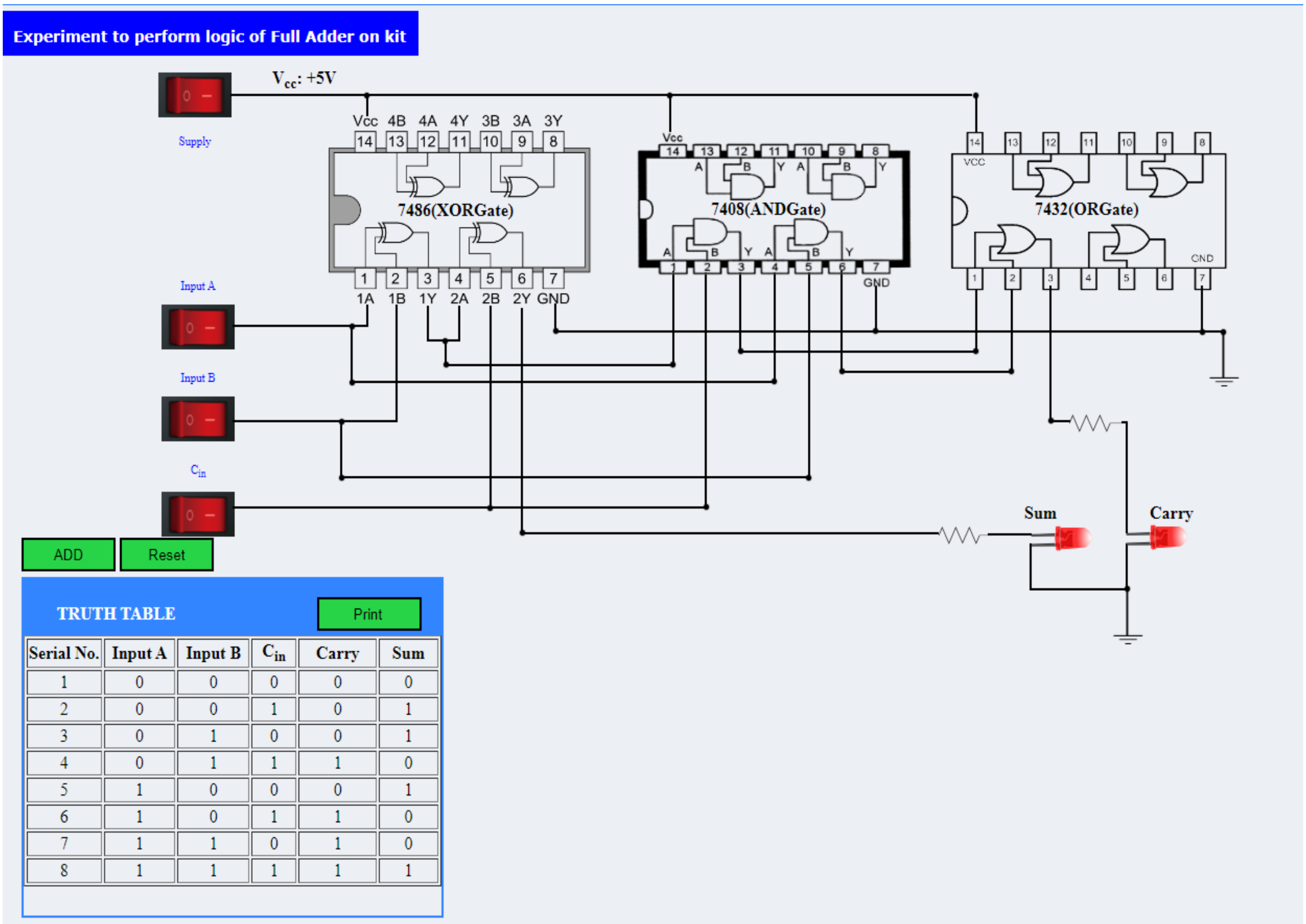
Circuit:



Serial No.	Input A	Input B	Sum	Carry
1	0	0	0	0
2	0	1	1	0
3	1	0	1	0
4	1	1	0	1

b) Full adder:

Circuit:



Serial No.	Input A	Input B	C_{in}	Carry	Sum
1	0	0	0	0	0
2	0	0	1	0	1
3	0	1	0	0	1
4	0	1	1	1	0
5	1	0	0	0	1
6	1	0	1	1	0
7	1	1	0	1	0
8	1	1	1	1	1

INFERENCE:

Half-Adder and Full-Adder Circuits were verified.