

Design of Half and Full Subtractor

Student Reg. No:

Experiment no. 5

Date:

Aim:

To implement half Subtractor and full Subtractor circuits using logic gates in LTSpice and tinker cad and verify the truth table.

Apparatus Required (tinkercad):

| Sl.No. | COMPONENT | SPECIFICATION | QTY. |
|--------|----------------|---------------|-------------|
| 1. | AND GATE | IC 7408 | 1 |
| 2. | X-OR GATE | IC 7486 | 1 |
| 3. | NOT GATE | IC 7404 | 1 |
| 4. | OR GATE | IC 7432 | 1 |
| 5. | IC TRAINER KIT | - | 1 |
| 6. | WIRES | - | AS REQUIRED |

THEORY:

HALF SUBTRACTOR:

The half Subtractor is constructed using X-OR and AND Gate. The half Subtractor has two input and two outputs. The outputs are difference and borrow. The difference can be applied using X-OR Gate, borrow output can be implemented using an AND Gate and an inverter.

FULL SUBTRACTOR:

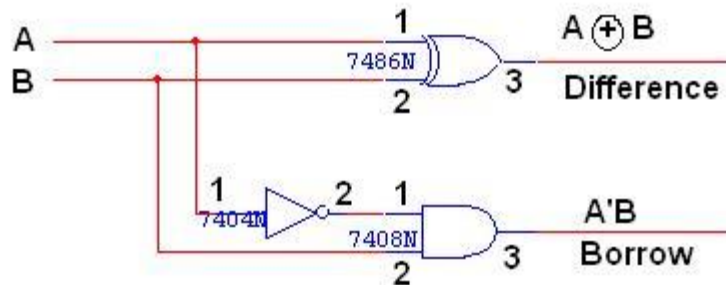
The full Subtractor is a combination of X-OR, AND, OR, NOT Gates. In a full Subtractor the logic circuit should have three inputs and two outputs. The two half Subtractor put together gives a full Subtractor. The first half Subtractor will be C and A B. The output will be difference output of full Subtractor. The expression AB assembles the borrow output of the half Subtractor and the second term is the inverted difference output of first X-OR.

HALF SUBTRACTOR

TRUTH TABLE:

| A | B | BORROW | DIFFERENCE |
|---|---|--------|------------|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 |

LOGIC DIAGRAM:

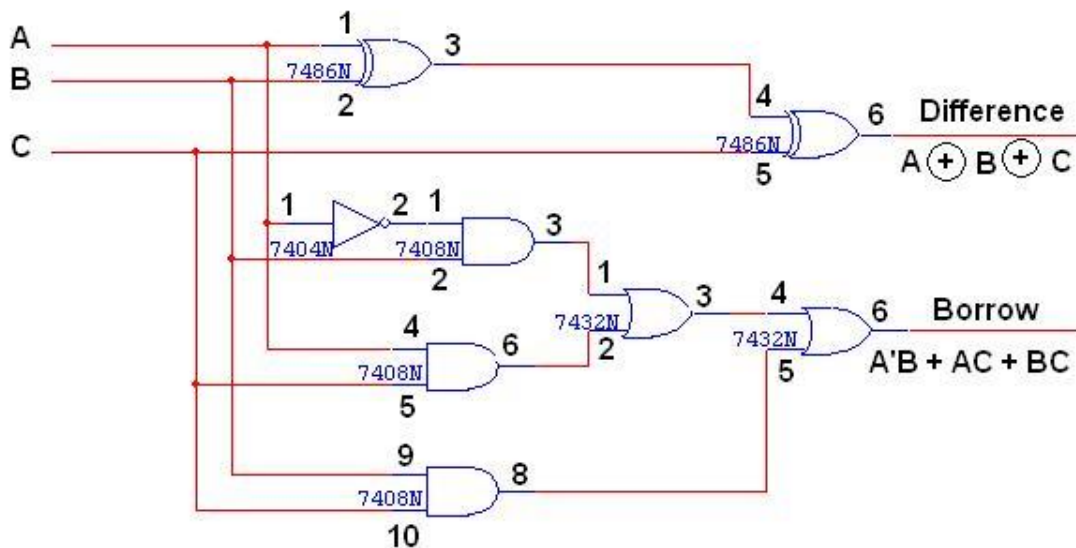


FULL SUBTRACTOR

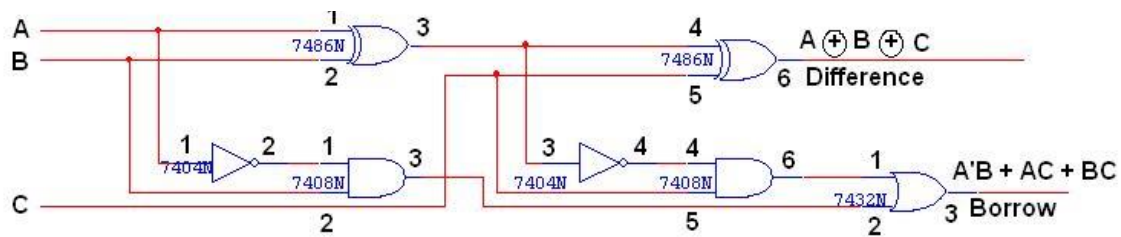
TRUTH TABLE:

| A | B | C | BORROW | DIFFERENCE |
|---|---|---|--------|------------|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

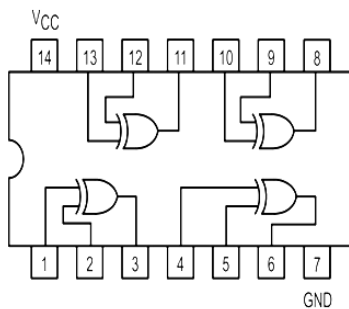
LOGIC DIAGRAM:



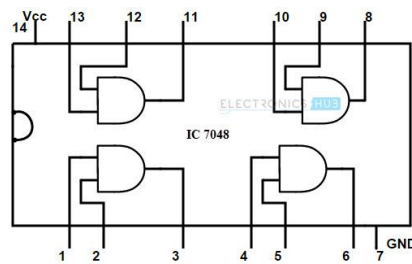
FULL SUBTRACTOR USING TWO HALF SUBTRACTOR:



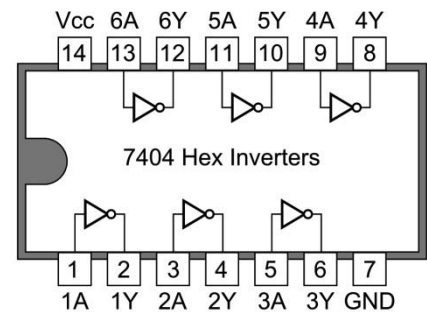
Pin Diagram of IC



IC7486



IC7048

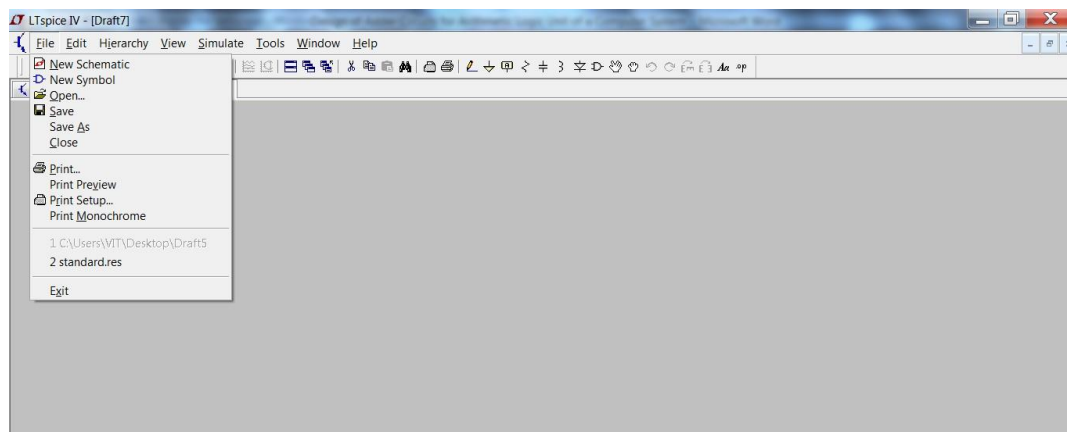


IC7404

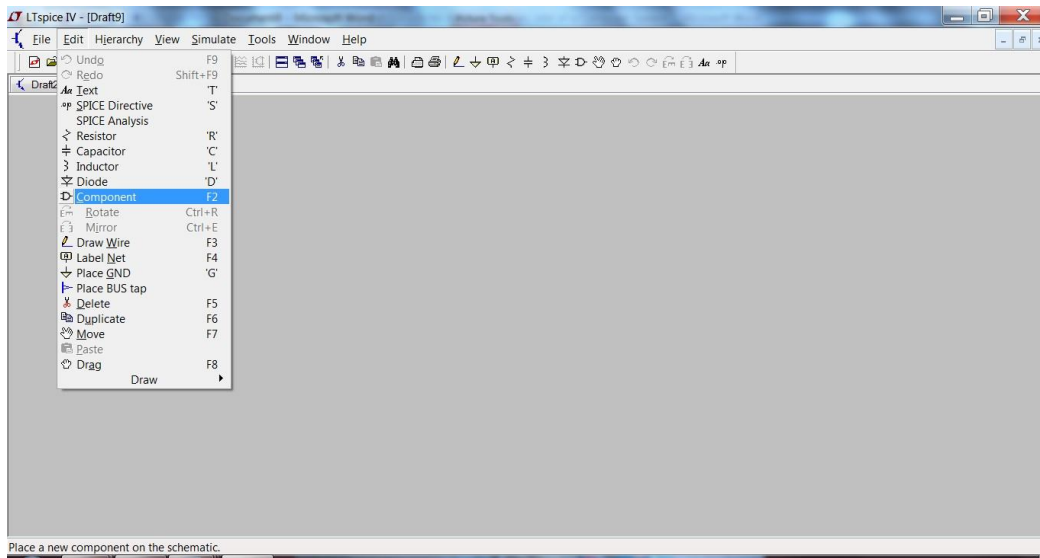
Implementation in LTspice Software:

Circuit Diagram of Half Subtractor in LTspice

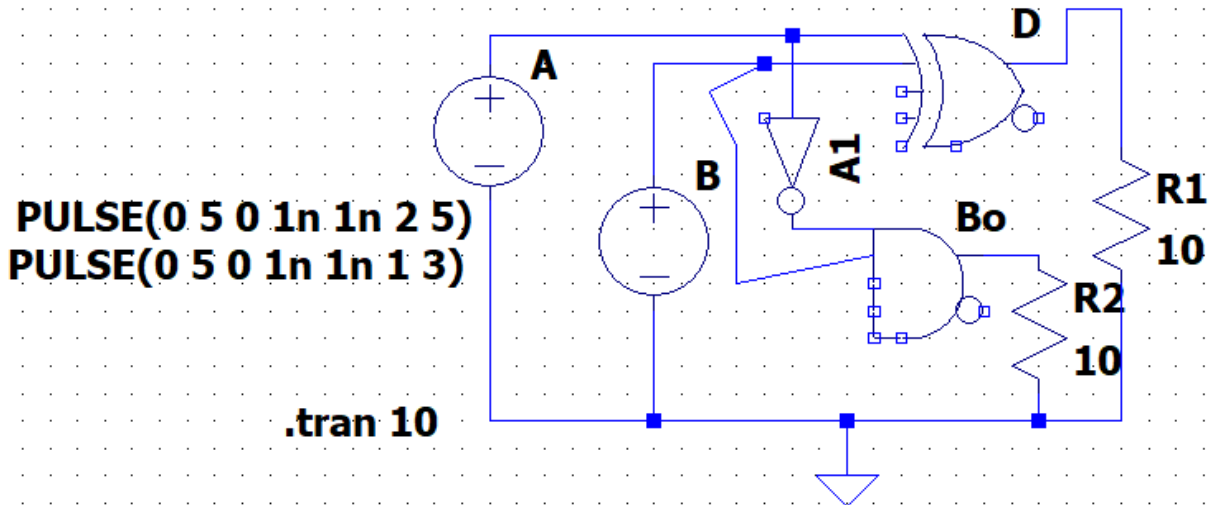
1. Open LTspice. Go to File – New Schematic.



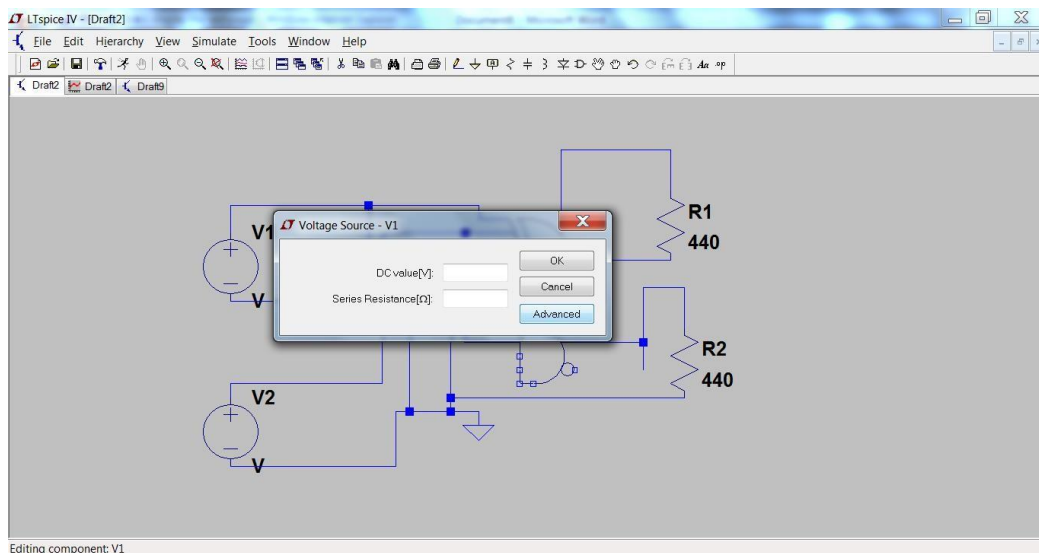
2. On the File Menu, click on Edit – Component.

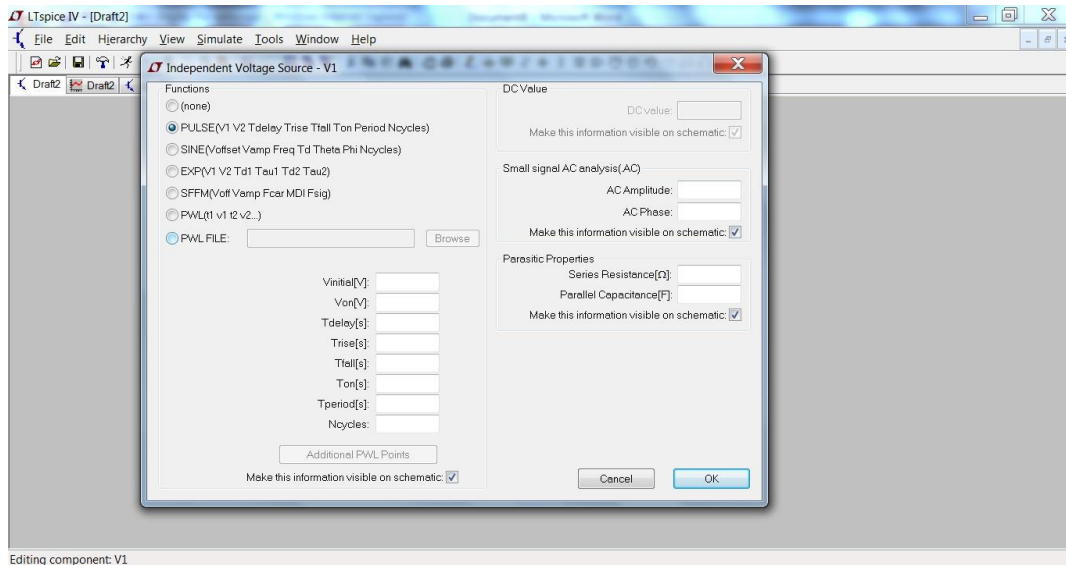


- Place the voltage sources, XOR gate, AND gate, NOT gate and ground on to schematic and make necessary connections as shown in the Figure.

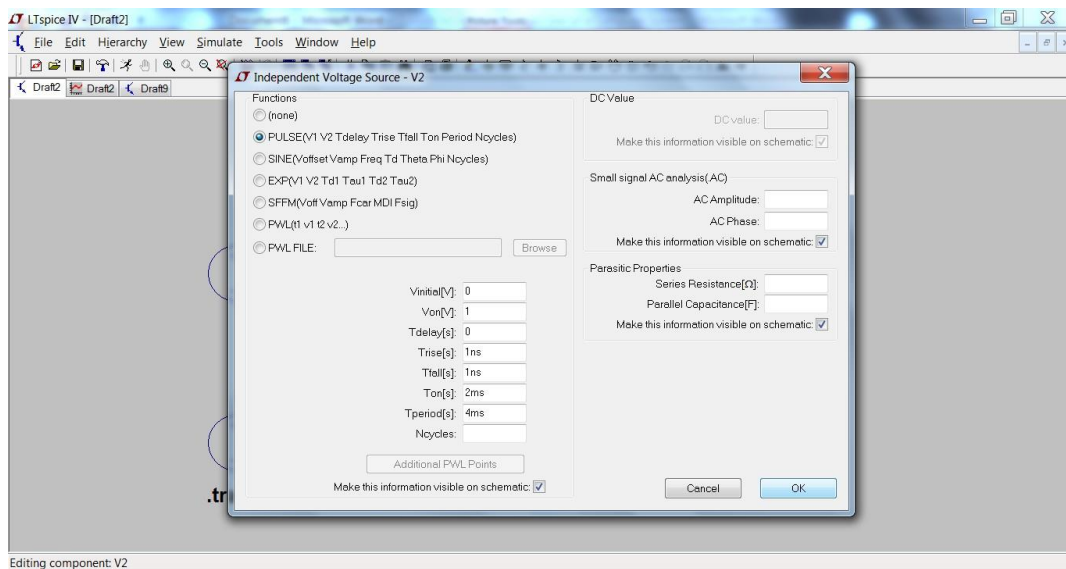


- As shown in the figures below, Right click on the voltage sources and click Advanced option and then Select PULSE (V1 V2 Tdelay Trise Tfall Ton Period Ncycles).

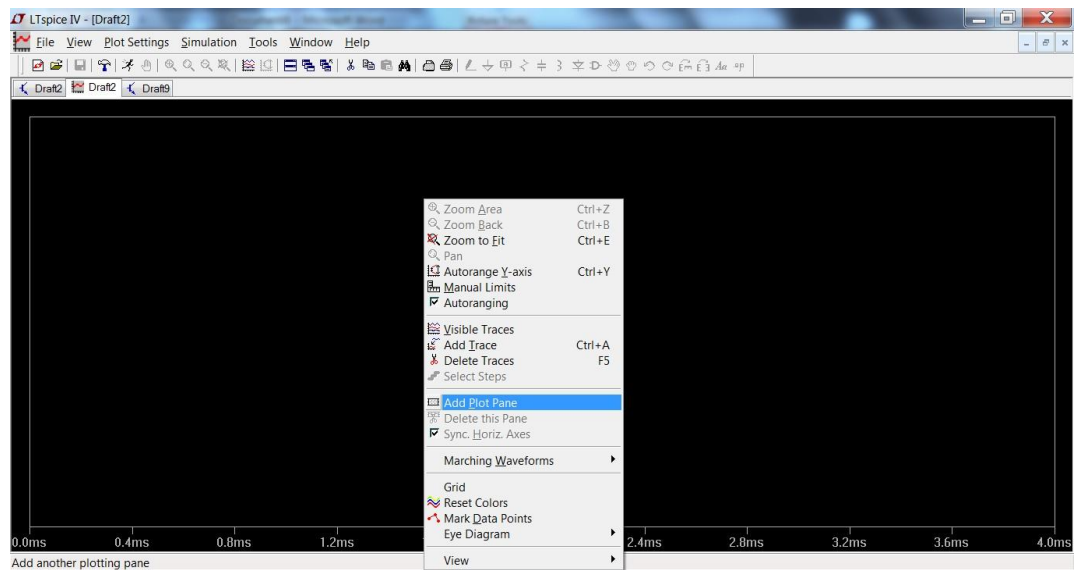




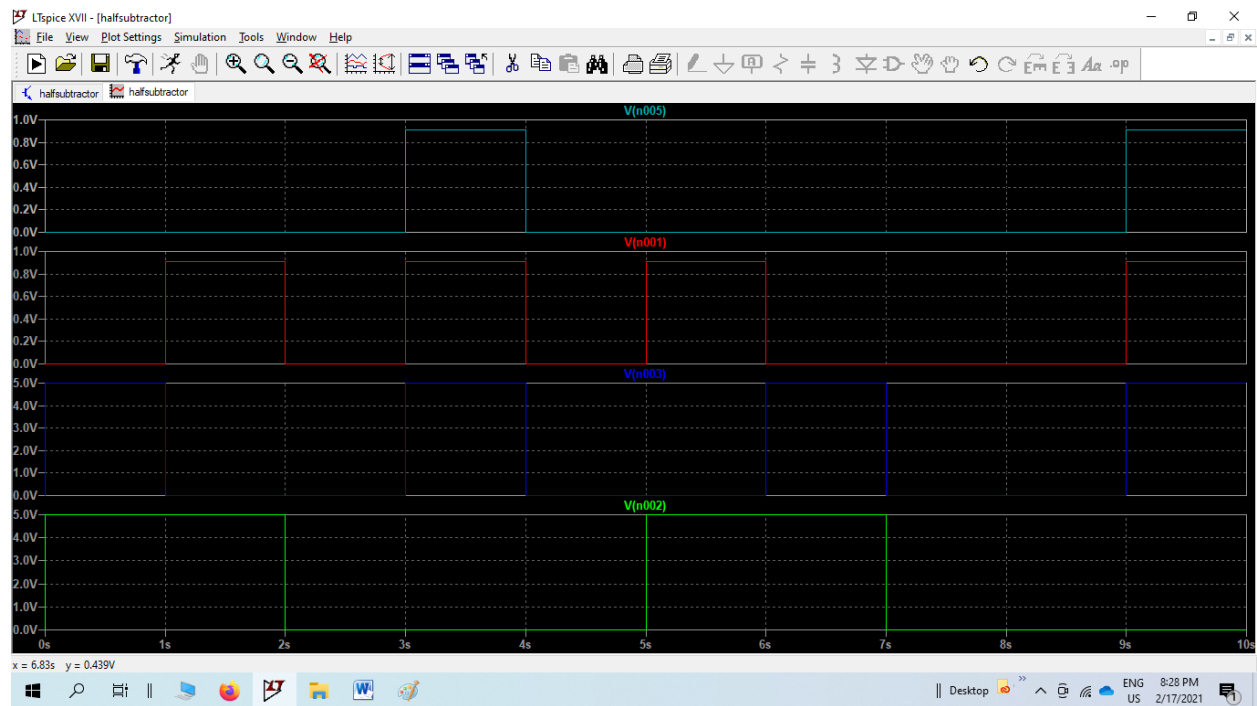
5. Set the values as (0, 1, 0, 1ns, 1ns, 1ms, 2 ms) for A, (0, 1, 0, 1ns, 1ns, 2ms, 4 ms) for B, as (0, 1, 0, 1ns, 1ns, 4 ms, 8 ms) for C



6. Go to Edit – SPICE analysis. Set the stop time to 8 ms in Transient command and run the simulation (run symbol on menu bar).
7. To view the results, right click – Add Plot Pane (add 5 plot panes to view the three inputs, sum and carry). For each pane, right click – Add Trace – Select V (<<respective node>>). (nodes correspond to input 1, input 2, input 3, sum and carry)

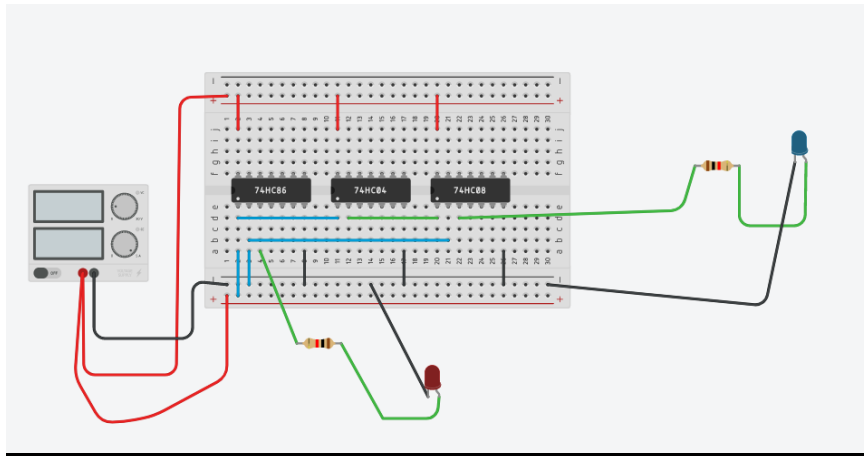


8. Observe the waveforms and verify the truth table.



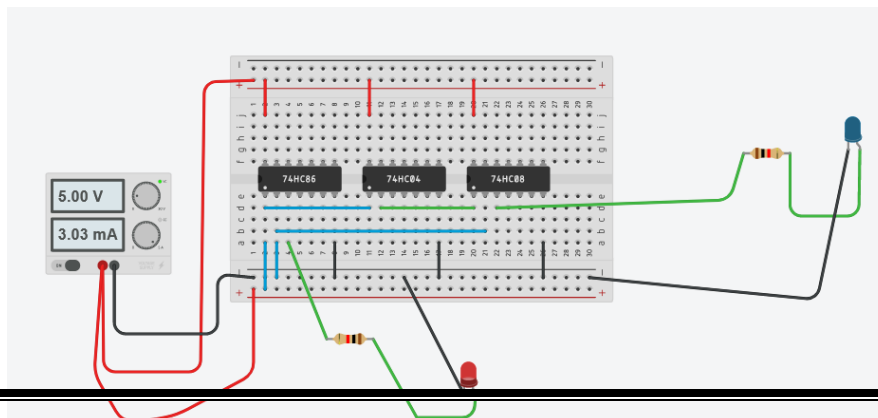
Implementation in tinkercad Software:

Circuit Diagram of Half Subtractor in tinkercad



Procedure for making Half Subtractor Circuit in tinkercad:

1. Launch tinkercad window.
2. Go to circuits and then create new circuit
3. Place the components required for the circuits.
4. Select the components based on the circuit requirements.
5. Connect the wires according to the circuit diagram. (In this given circuit drawn in tinkercad, red wires are +ve power supply and –ve supply represents black wires. Blue wires are the inputs and green wires are the output.)
6. The two outputs are difference (Red – LED) and borrow (Blue – LED).
7. Then start the simulation.



8. Observe the output LED displays on the screen.

Output of the Half Subtractor Circuit diagram

The output is shown at A=1;B=0; Difference =1; Borrow=0 Hence Red LED glows

Students Work

Circuit Diagram of Half Subtractor in LTSpice

Student to do

Output of the Half Subtractor Circuit diagram

Student to do

Circuit Diagram of Full Subtractor in LTSpice

Student to do

Output of the Full Subtractor Circuit diagram

Student to do

Circuit Diagram of the Half Subtractor in tinkercad

Student to do

Output of the Half Subtractor in tinkercad

Student to do

Circuit Diagram of the Full Subtractor in tinkercad

Student to do

Output of the Full Subtractor in tinkercad

Student to do

RESULT:

Thus the half Subtractor and full Subtractor were designed and their truth table is verified.