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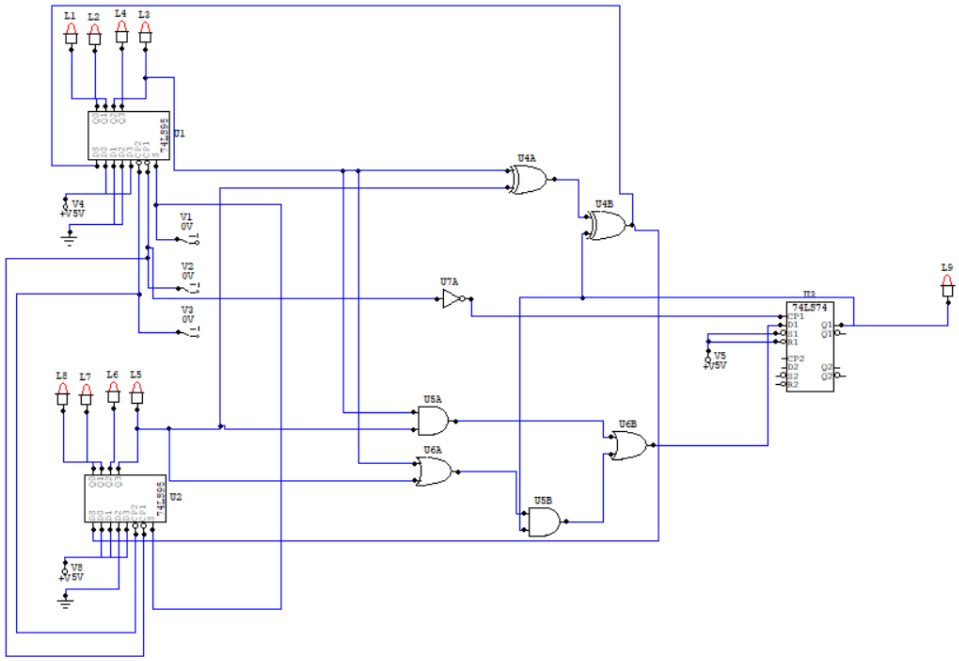
DIGITAL LABORATORY EXPERIMENT 3

AIM:

Using a serial adder, compute the sum of two 4-bit binary numbers and display the 4-bit sum and carry output on logic displays.

CIRCUIT DIAGRAM



This is the circuit used for the simulation of this experiment where we use lamps to show binary value, LOW (0) and HIGH (1), two IC 7495 and a IC 7474 and a few logic gates to realize this circuit model.

BREIF THEORY AND EXPLAINATION

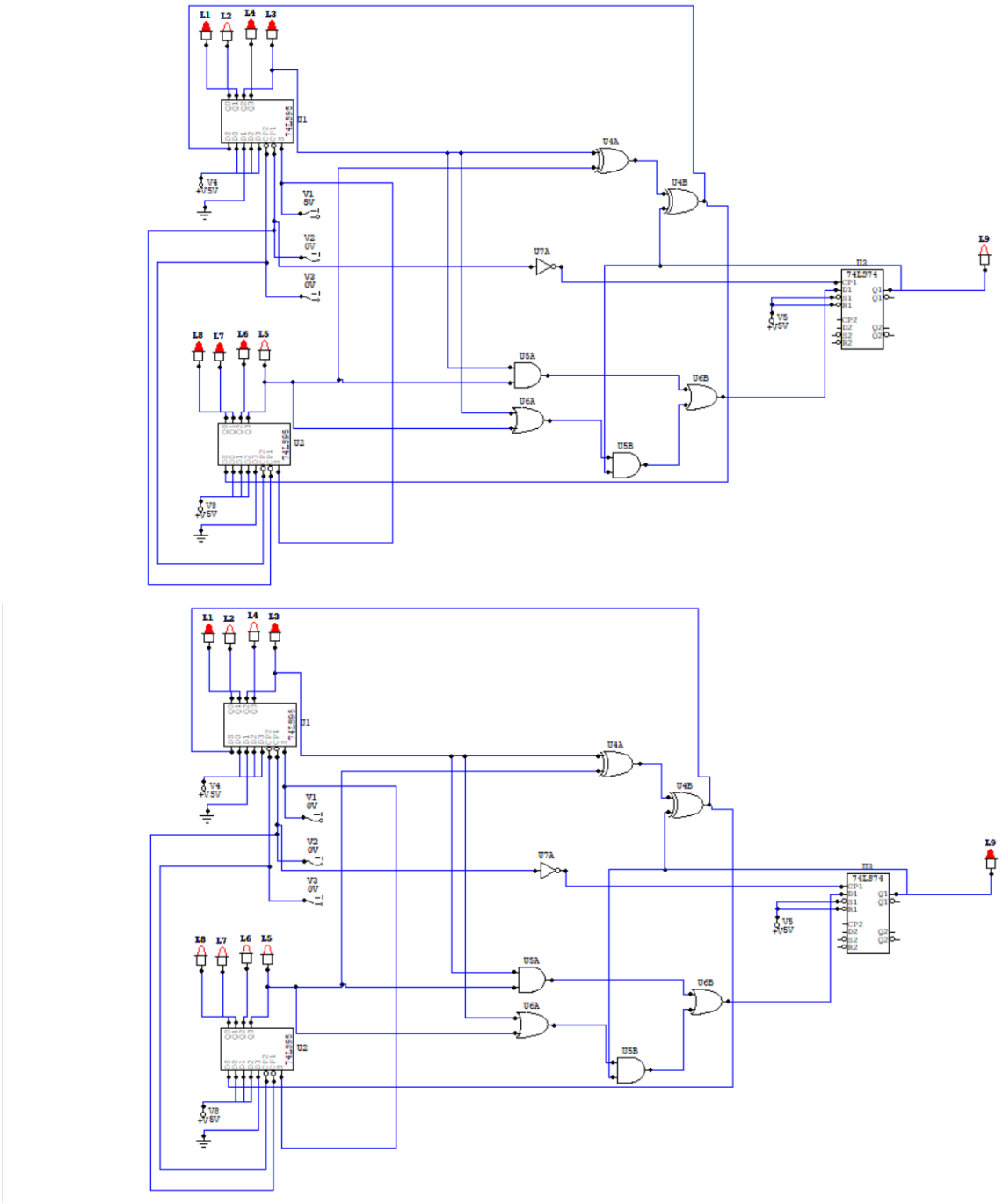
In order to have a circuit like serial adder, we need a way to input binary numbers and a way to display to show the result of our operation. We use digital lamps to show the results as well as the inputs we gave in at the start. So, we need a device to show the binary code we entered, for that purpose we use IC 7495, which are a 4-bit shift registers with serial and parallel synchronous operating modes. We need to give input in form of HIGH and LOW to D0-D3 pins by connecting to either ground or digital voltage supply, then we can see the result on the lamps connected to the Q0-Q3 pins of the IC, we have four more pins namely S, CP1, CP2 and DS. We connect first three pins to a manual switch to switch it between high and low. This setup can be used to take inputs from D0-D3 pins and show output from Q0-Q3 pins. Now, we need a way to show the last ending binary digit, 5^{th} digit place in a way so that we can show the result of the addition. For that we use an IC 7474, which is a dual positive edge triggered D-type FF. We make connections between the addend and augend units and our 7474 with the help of a 1-bit adder. We need to use the shifting property of 7495 and integrate that with the additional lamp we connected to 7474 to do the adding operation, we take inputs of addend bit and augend bit and get the a output bit and sum pin, the sum pin is sent back to the addend unit to display the end result, while we add 1+1, we need to carry the output value to next cycle operation of shifting where we add digits at the next place, for this purpose, we store that value at another place, which is the lamp at 7474. We take the output from that lamp pin and send it back to carry input bit for the next addition operation. In this way we will get the result after 4 cycles where the final result can be seen with the help of 4lamps on the addend unit and the other lamp on 7474 unit (5^{th} digit place). We follow a sequence of switching on and off of S, CP1, CP2 pins in order to achieve this,

Switch on the S pin, and then give a high to low signal to CP1 pin for once to show the input values on addend and augend units. Then we need to switch off the S pin and start giving a series of 4 high-to-low signals to CP2 to get the end result.

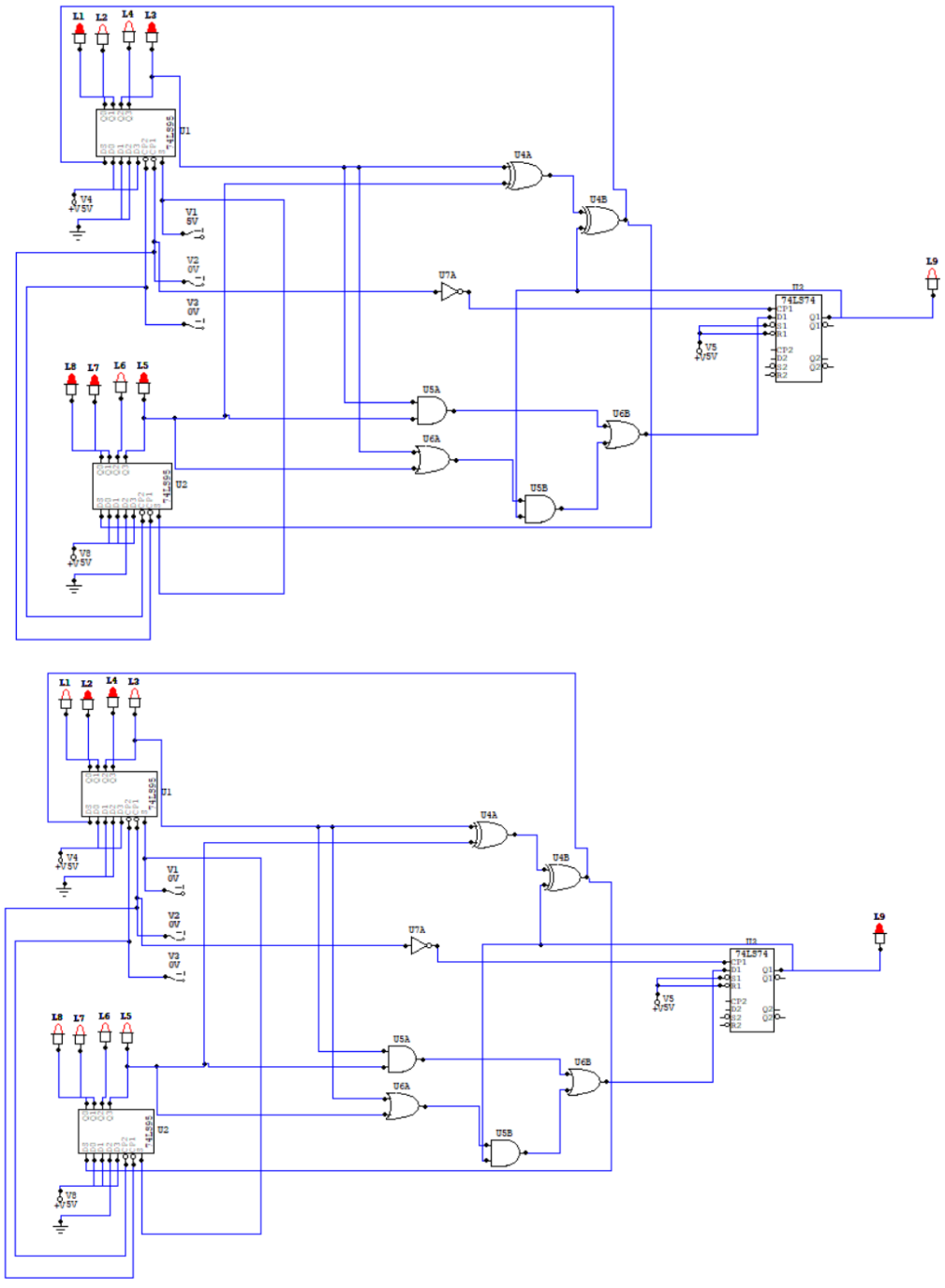
SNAPSHOTS OF THE SIMULATION:

To show the results of the simulations, I have taken 8examples of binary additions, where the first image shows the inputs and next image shows output answer.

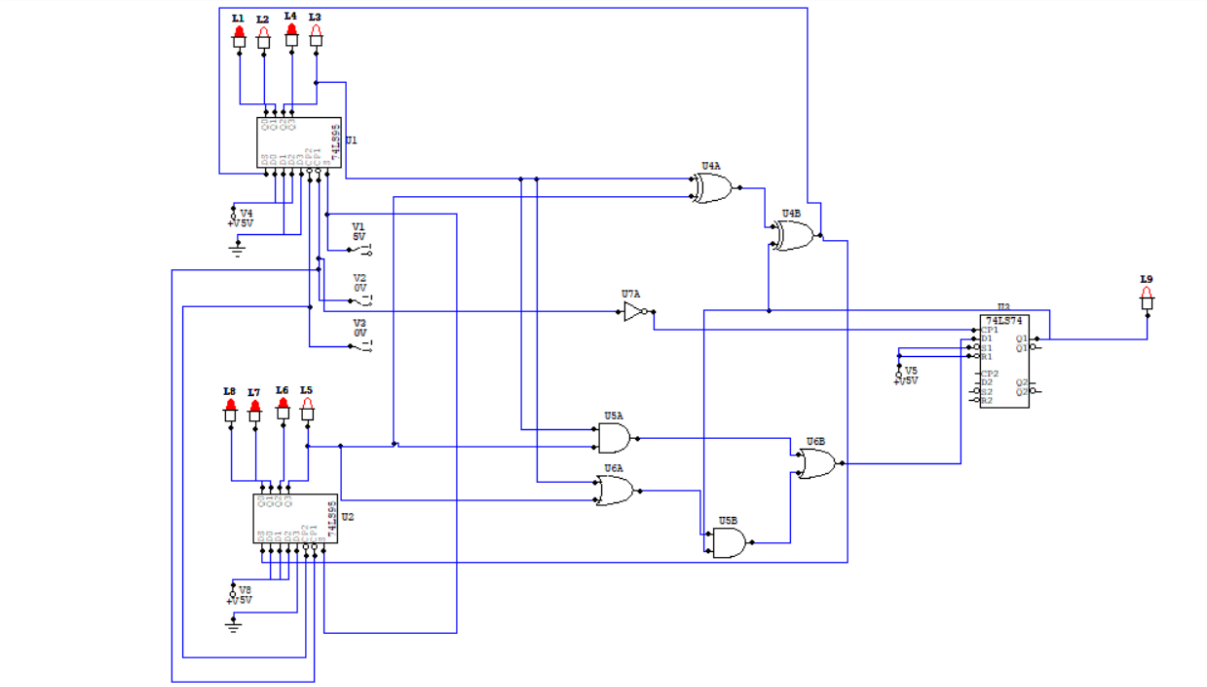
Example1: 1011 + 1110 = 11001

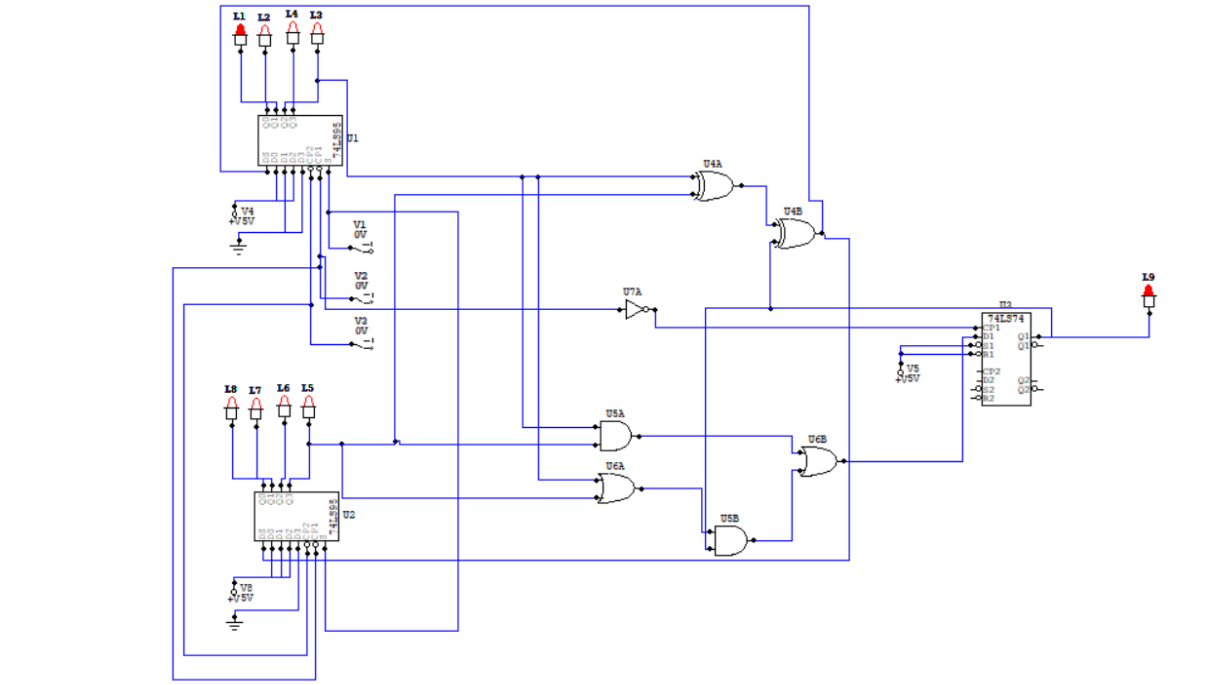


<u>Example2:</u> 1001 + 1101 = 10110

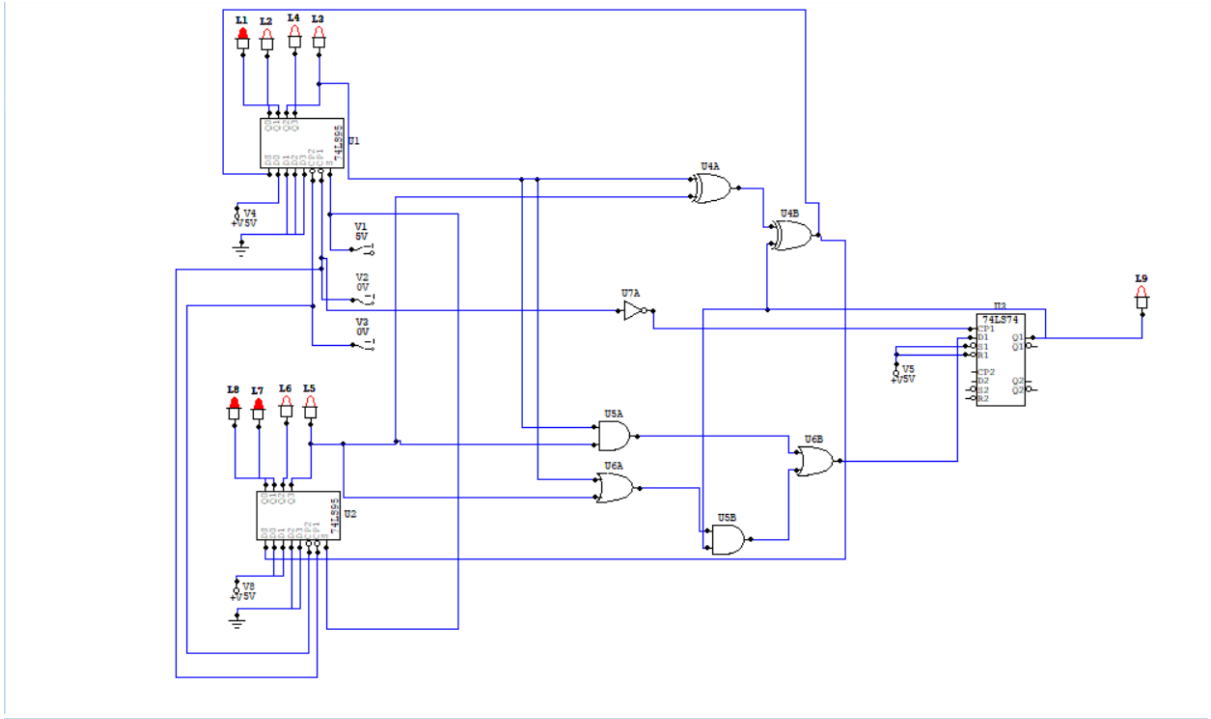


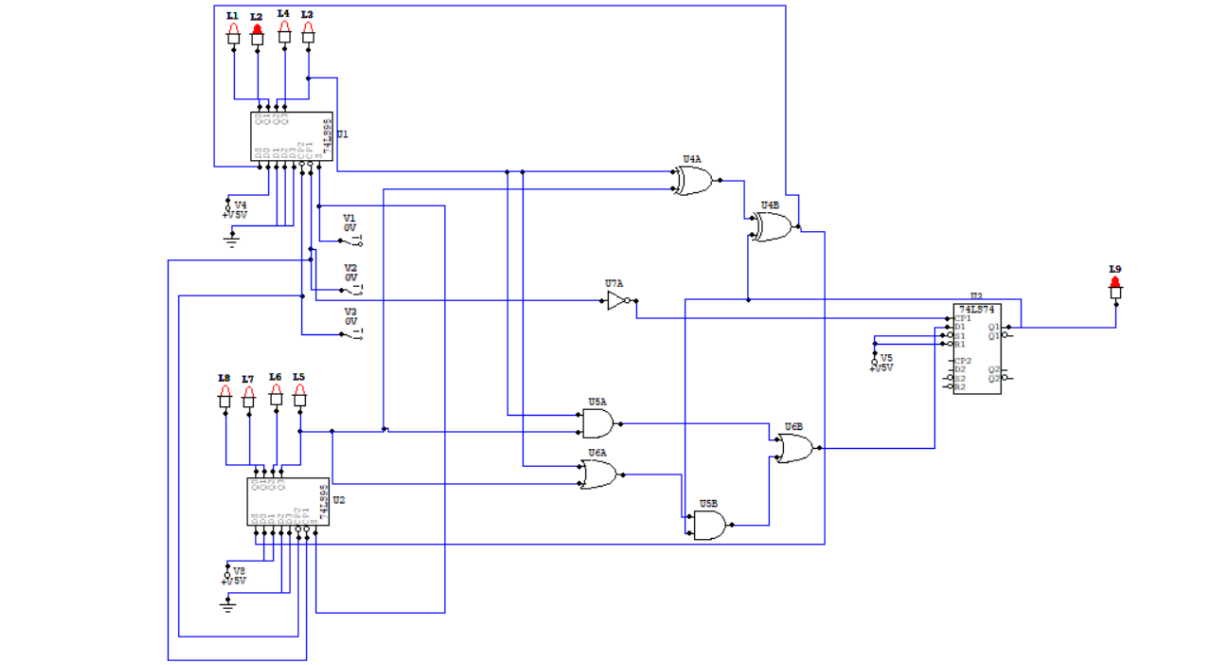
<u>Example3</u>: 1010 + 1110 = 11000



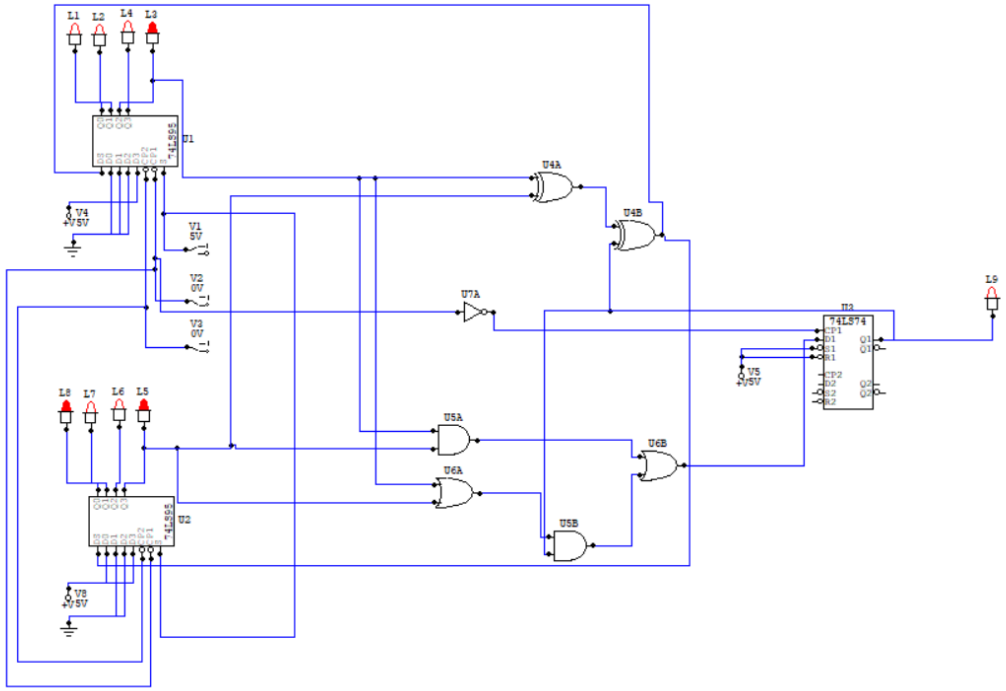


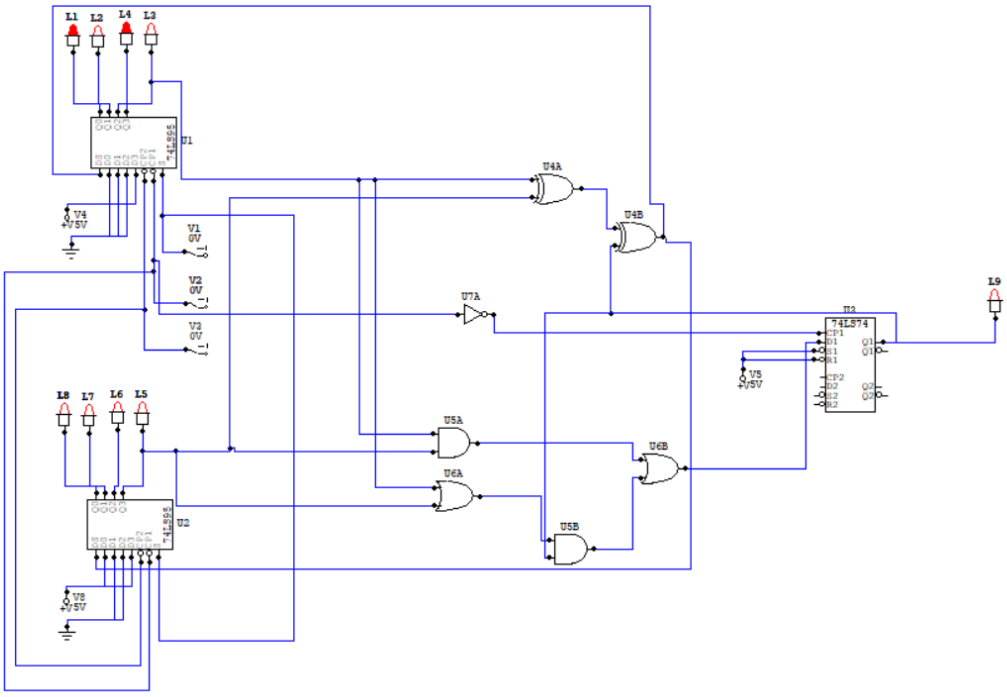
<u>Example4</u>: 1000 + 1100 = 10100



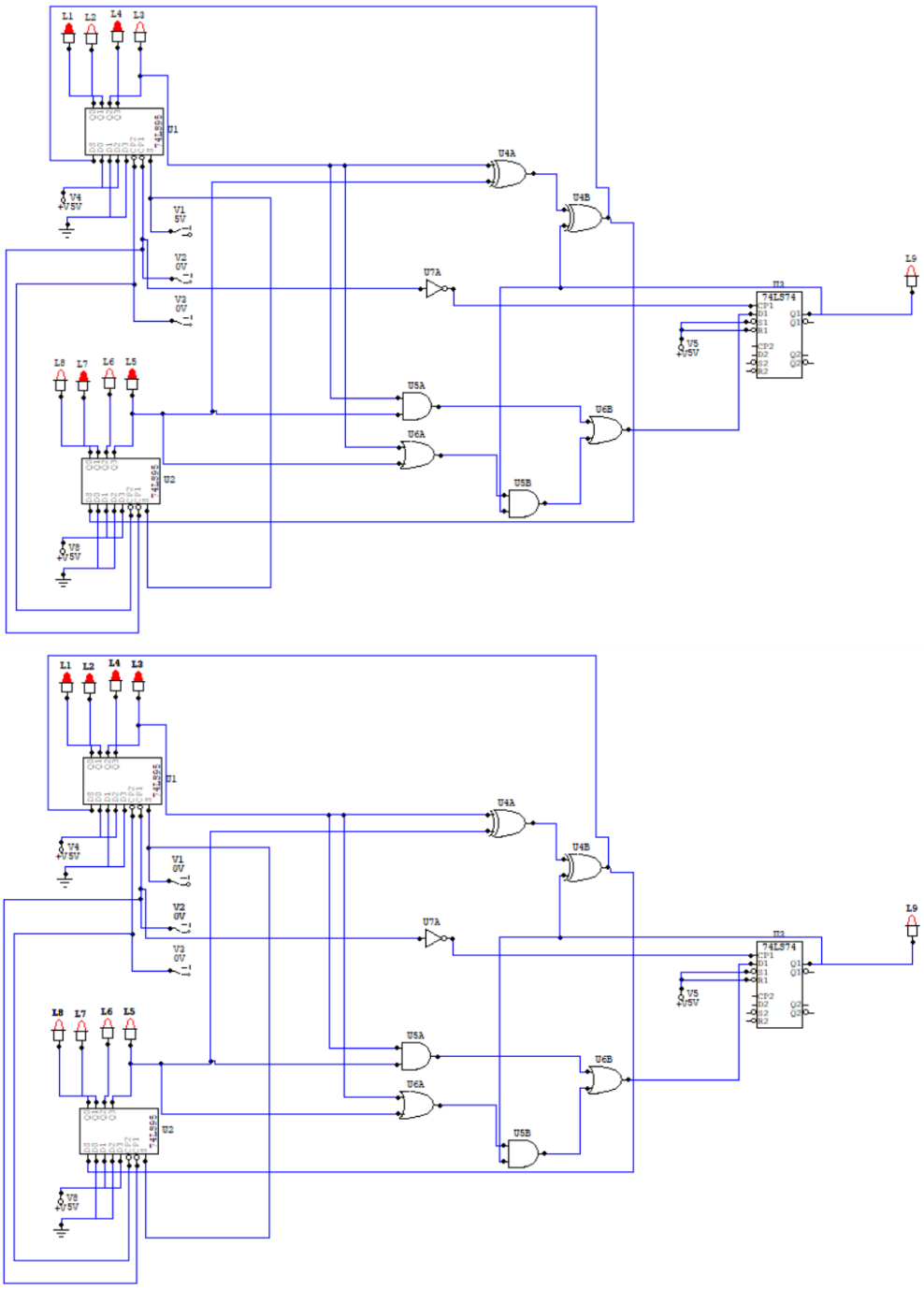


<u>Example5</u>: 0001 + 1001 = 01010

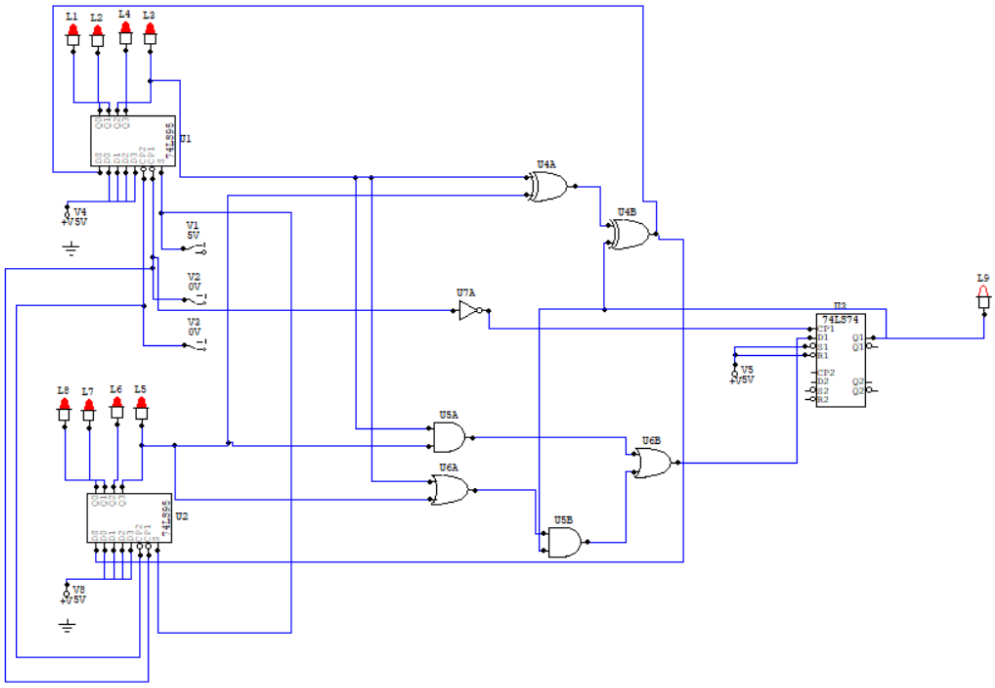


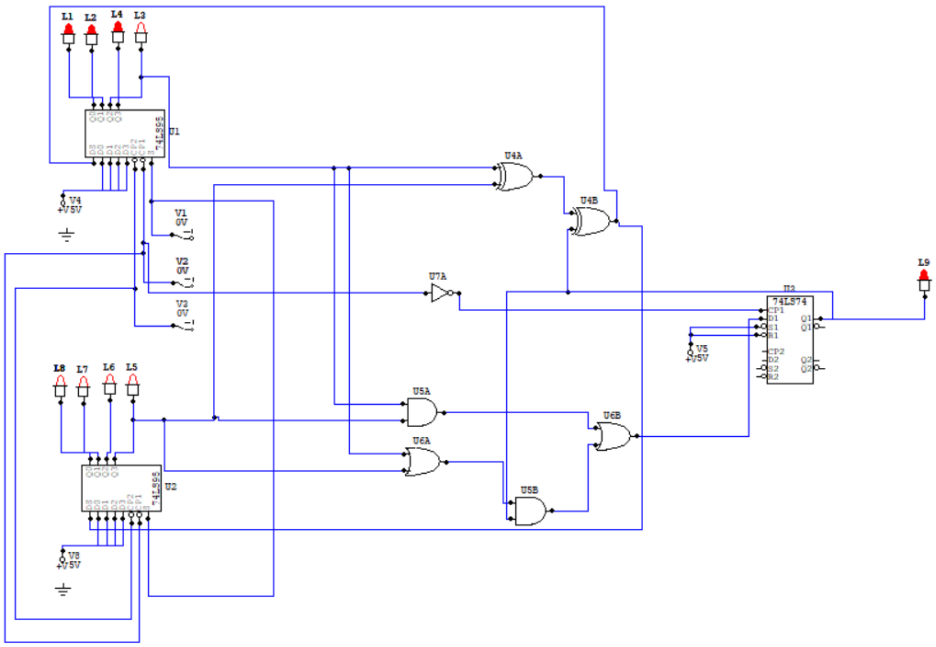


<u>Example6</u>: 1010 + 0101 = 01111

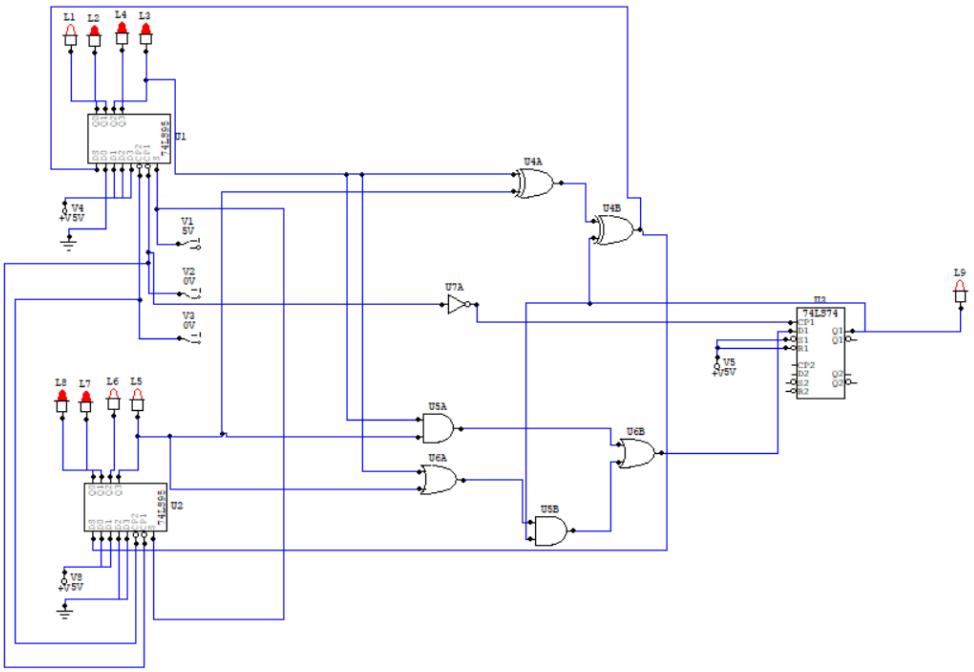


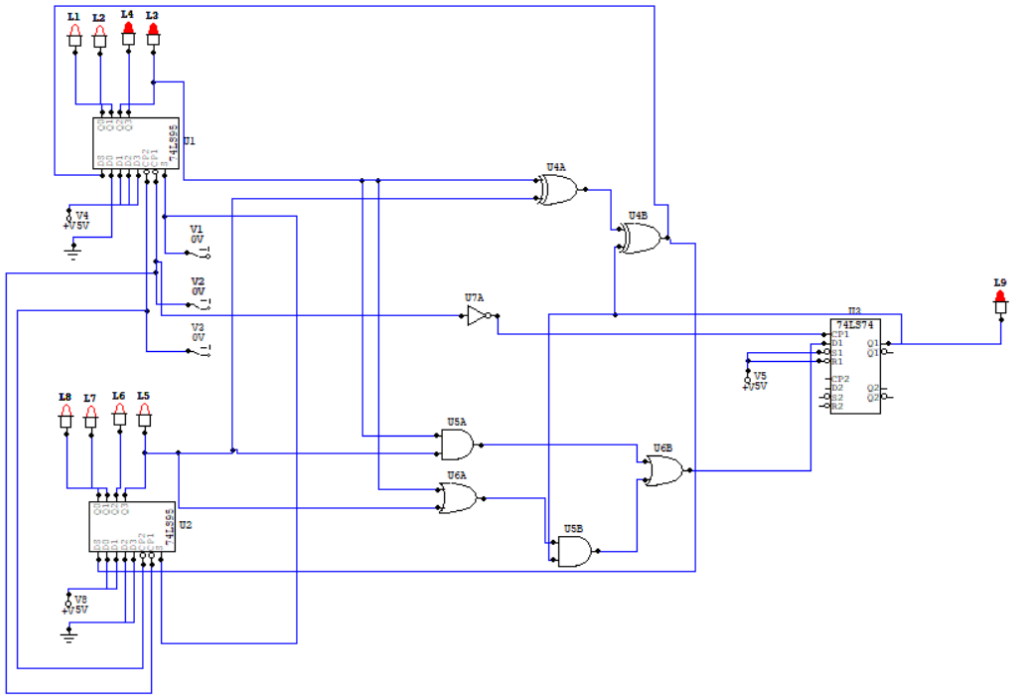
<u>Example7</u>: 1111 + 1111 = 11110





Example8: 0111 + 1100 = 10011





OBSERVATION AND CONCLUSION

As we expect to see, in the second image of each page shows the answer with 5th digit lamp at the very right to the circuit. I have attached the .ckt file along with the report in submission. That takes us to the end of this experiment.