

Name of Experiment: Analysis and Synthesis of Boolean Expressions using Basic Logic Gates.

Aim of the Experiment: The Principal objective of this experiment is to fully understand the function and use of logic gates such as 7400(quad 2-input NAND gates), 7402(quad 2-input NOR gates), 7404(Hex inverter) 7408(quad 2-input AND gates), 7432(quad 2-input OR gates).

Theory

Analysis of Logic gates using 7400(quad 2-input NAND gates), 7402(quad 2-input NOR gates), 7404(HEX inverter), 7408(quad 2-input AND gates), 7432(quad 2-input OR gates). Diagrams of each chip are shown in Figure.

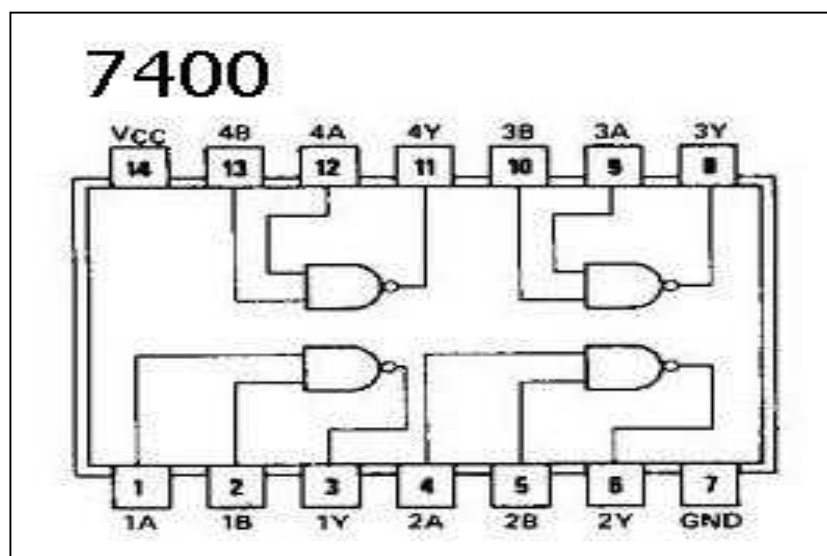


Figure- 1

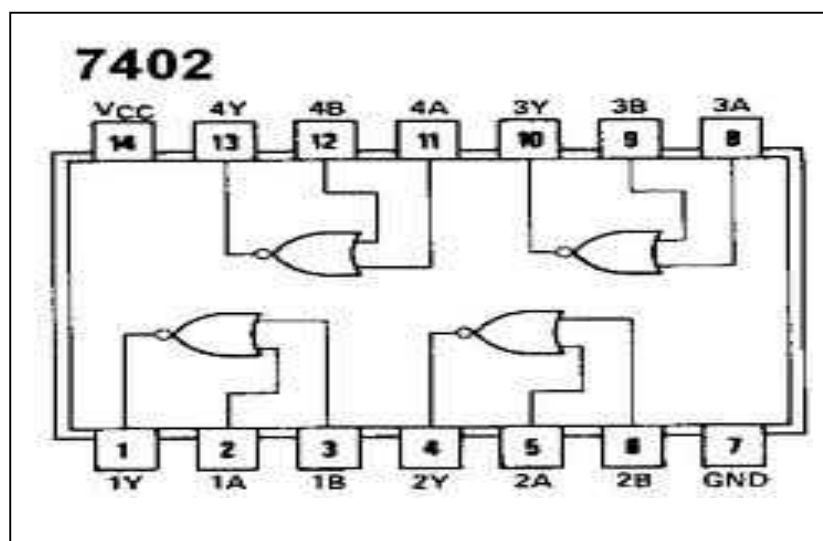


Figure- 2

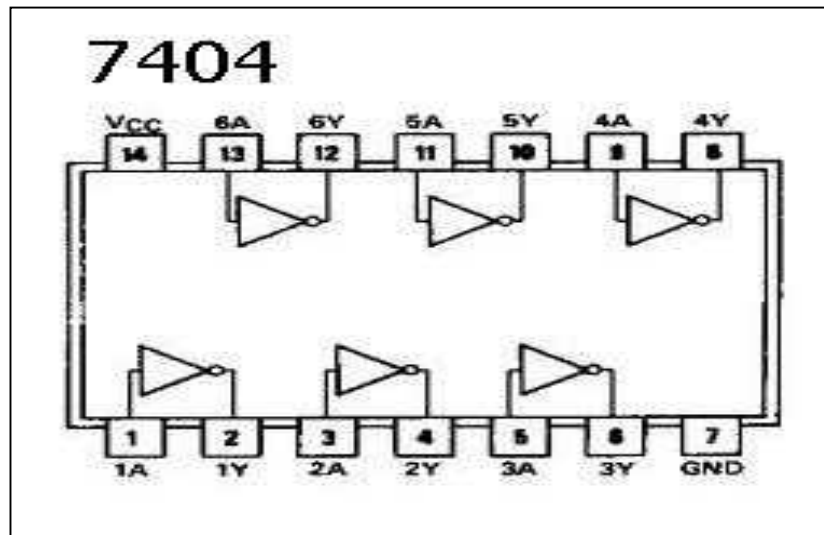


Figure- 3

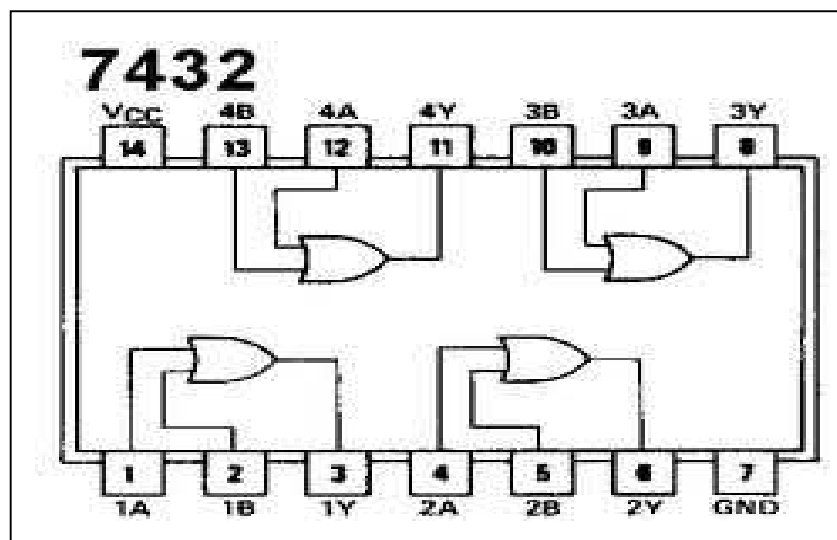


Figure- 4

Fig: 1 . 7400(quad 2 input NAND gates) Fig: 2 . 7402 (quad 2 input NOR gates)

Fig: 3 . 7404(HEX inverter) Fig: 4 . 7432(quad 2-input OR gates).

$$(a) AB + \bar{A}C + BC - AB + \bar{A}C$$

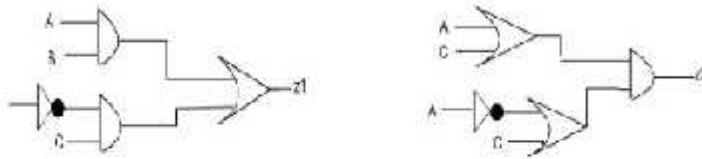
According to consensus theorem, the Boolean identity holds.



In the above picture both circuits are equivalent.

$$(b) AB + \bar{A}C = (A+C)(\bar{A}+B)$$

According to consensus theorem, the Boolean identity holds.



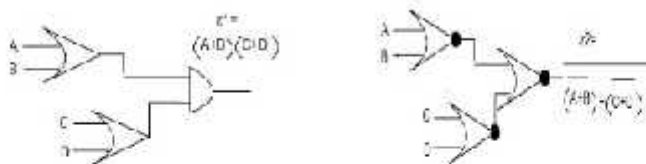
In the above picture both circuits are equivalent.

(c) Verify equivalence of AND-OR and NAND-NAND structure



In the above picture both circuits are equivalent.

(d) Verify equivalence of OR-AND and NOR-NOR structure



In the above picture both circuits are equivalent.

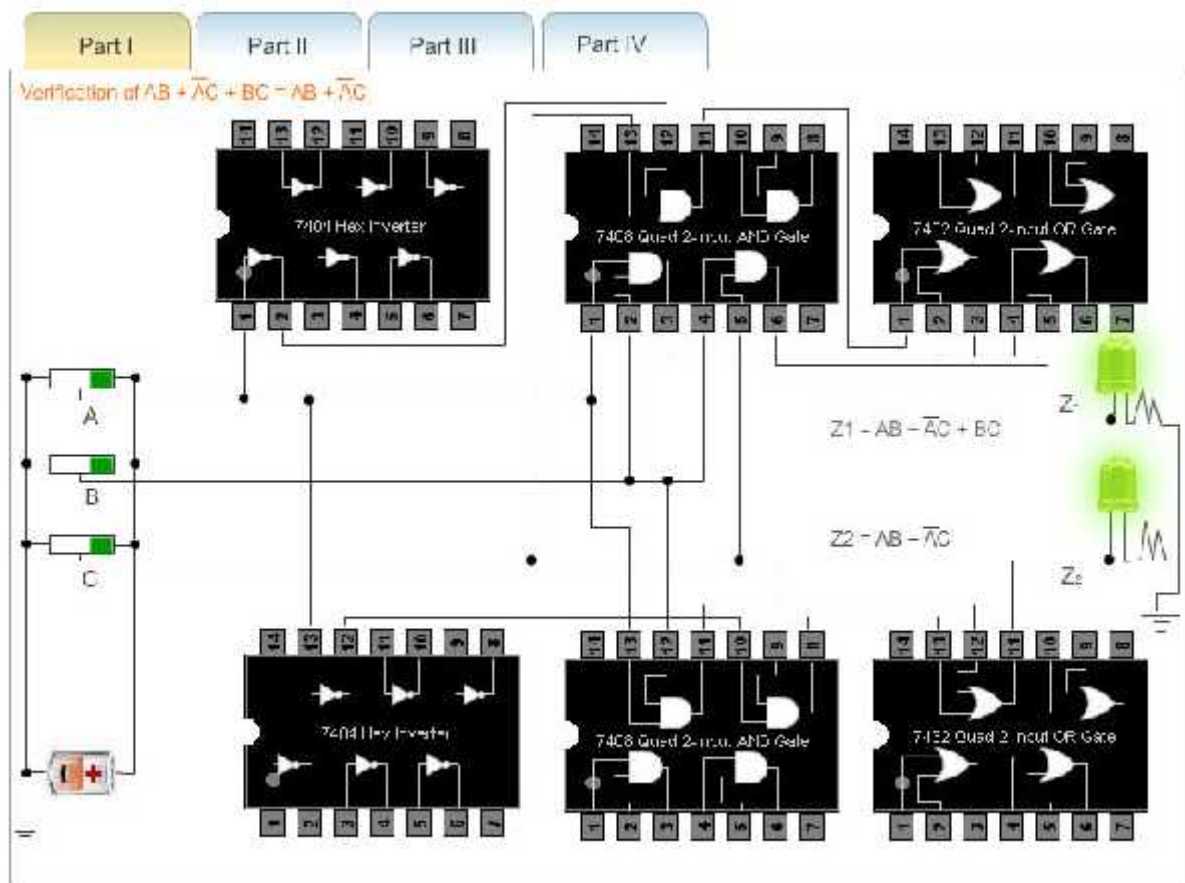
Student may be asked to wire up the network of gates shown in the above figures. They can next verify that the output of the two circuits, viz z1 and z2 should attain the same value for each of the eight possible input combinations assigned to the variables A, B, C, and D.

Procedure

Please follow these steps to do the experiment.

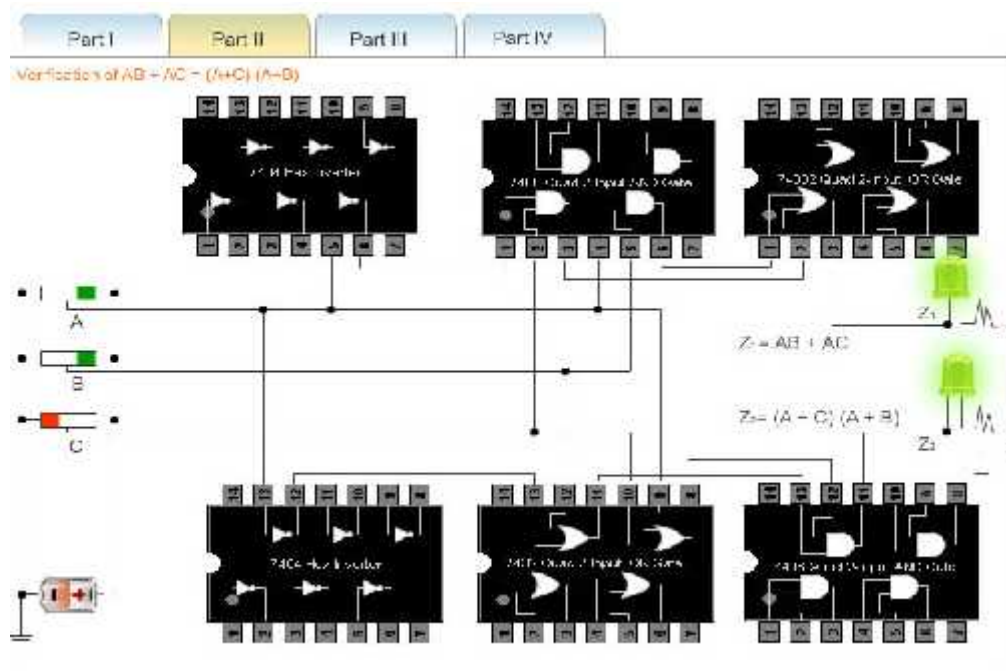
Part 1.

1. At first go through the structure of 7404 Hex inverter, 7408 (quad 2-input AND gates), 7432 (quad 2-input OR gates).
2. Next, apply a high level voltage to all the inputs A, B, C.
3. Next, check that both LEDs glow. This is because both the outputs z1 and z2 attain the same value.
4. Thus, $AB + \bar{A}C + BC = AB + \bar{A}C$ holds for the condition $A=B=C=1$.
5. For all the combinations of the variables A, B, and C verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level. Similarly a dark LED indicates low level output voltage.



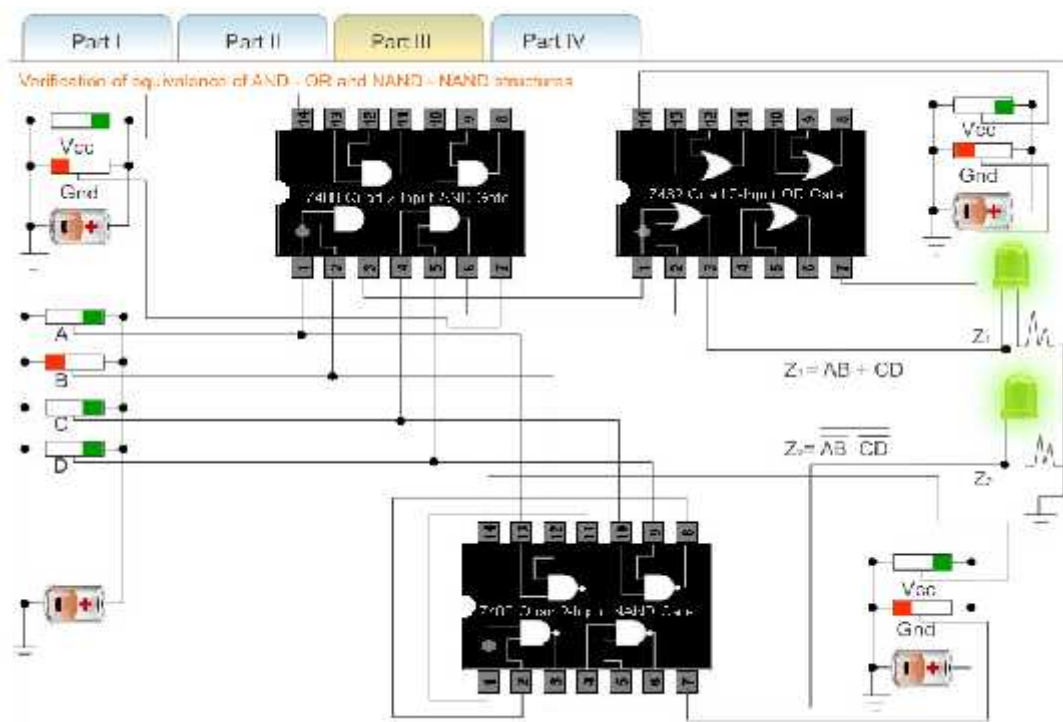
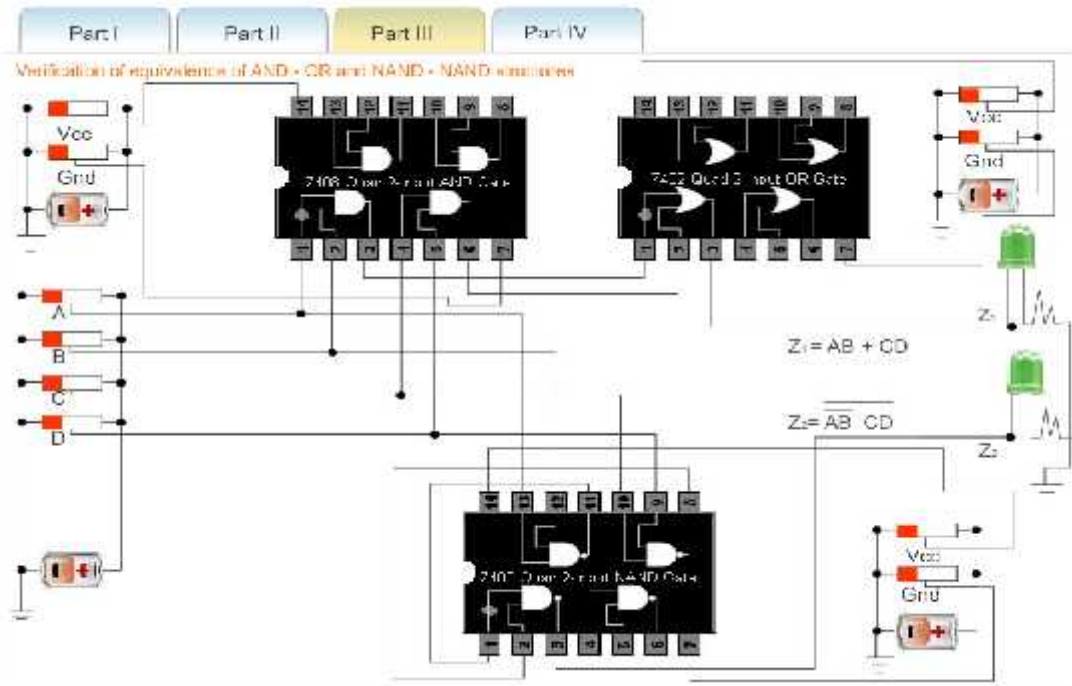
Part 2:

1. At first go through the structure of 7400(quad 2-input NAND gates), 7408(quad 2-input AND gates), 7432(quad 2-input OR gates).
2. Next, apply a high level voltage to inputs A,B and apply low level voltage to the input C.
3. Next, check that both LEDs glow. This is because both the outputs Z_1 and Z_2 attain the same value.
4. So, the equivalence of AND-OR and NAND NAND structure can be verified.
5. For all the combinations of the variables A,B and C verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level. Similarly a dark LED indicates low level output voltage.



Part 3:

1. At first go through the structure of 7404 Hex inverter, 7408(quad 2-input AND gates), 7432(quad 2-input OR gates), 7400(quad 2-input NAND gates).
2. Next, apply a high level voltage to all the Vcc inputs and keep low level voltage to all the Gnd inputs. If Vcc and ground are not connected properly then error message will be appeared and no output will be generated.
3. Next, apply a high level voltage to the inputs A,B and apply low level voltage to the input C.
4. Next, check that both LEDs glow. This is because both the outputs z1 and z2 attain the same value.
5. Thus, $AB + AC - BC = AB - AC = (A - C)(A + B)$ holds for the condition $A=B="1"$ and $C=D="0"$
6. For all the combinations of the variables A,B and C verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level. Similarly a dark LED indicates low level output voltage



Part 4:

1. At first go through the structure of 7402(quad 2-input NOR gates), 7408(quad 2-input AND gates), 7432(quad 2-input OR gates).
2. Next, apply a high level voltage to all the Vcc inputs and apply low level voltage to all the Gnd inputs. If Vcc and ground are not connected properly then error message will be appeared and no output will be generated.
3. Next, apply a high level voltage to all the inputs A,C and apply low level voltage to the inputs B,D.
4. Next, check that both LEDs glow. This is because both the outputs z1 and z2 attain the same value.
5. So, the equivalence of OR-AND and NOR-NOR structure can be verified.
6. For all the combinations of the variables A,B,C and D verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level. Similarly a dark LED indicates low level output voltage.

