Report

COURSE: CSE 206
EXPERIMENT NO: 2
TOPIC: Truth tables and simplification using Boolean
Algebra

SUBMITTED BY:
1805021 - Abdus Samee
1805022 - Md. Tamimul Ehsan
1805023 - Mohammad Abrarul Hasanat
1805024 - Zannatul Naim
1805025 - Md. Fahim Shahriar

Problem - 1

<u>Problem specification:</u>
Simplify the following equation using Boolean algebra and implement it.

F(A,B,C,D) =
A'B'C'D'+ABCD+ABC'D+A'B'CD'+A'BC'D+AB'C'D'+AB'CD'+A'BCD

<u>Required instruments:</u>
(1) 2 input pins, (2) 1 output pins, (3) 1 IC7404 gate, (4) 1 IC7408 gate, (5) 1 IC7432 gate, (6) Wires.

<u>Truth table;</u>

We construct the following table following the inputs of A, B, C, and D and observe the output at X. Here, X = A'B'C'D'+ABCD+ABC'D+A'B'CD'+A'BC'D+AB'C'D'+AB'CD'+A'BCD. The output here resembles those input combinations for which its state is ON.
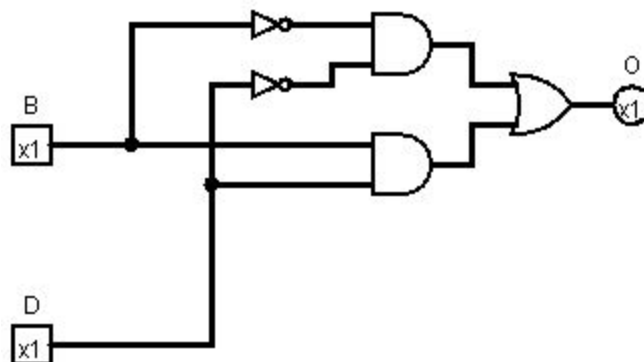
A	B	C	D	X
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1

1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Minimized equation:

A'B'C'D'+ABCD+ABC'D+A'B'CD'+A'BC'D+AB'C'D'+AB'CD'+A'BCD
= A'B'D'(C+C') + ABD(C+C') + A'BD(C+C') + AB'D'(C+C')
= A'B'D' + ABD + A'BD + AB'D'
= BD(A+A') + B'D'(A+A')
= BD + B'D'

Circuit diagram:

Observation: Upon simplification of the circuit, we see that the output equals that of an X-NOR gate. So in place of the AND, OR, and NOT gates, a single X-NOR gate can also be used.

Problem - 2

Problem specification:
Derive the equations for a 3 bit gray to binary converter from Truth Table and implement those with the required gates.

Required instruments:
(1) 3 input pins, (2) 3 output pins, (3) 1 IC7404 gate, (4) 2 IC7408 gates, (5) 1 IC7432 gates, (6) Wires.

Truth table:
We construct the following table following the inputs of A, B, and C and observe the output at X and Y. The expressions have been built with those combinations of the inputs for which the output corresponds to an ON signal.

A	B	C	X	Y	Z
0	0	0	0	0	0
0	0	1	0	0	1
0	1	1	0	1	0
0	1	0	0	1	1
1	1	0	1	0	0
1	1	1	1	0	1

1	0	1	1	1	0
1	0	0	1	1	1

Minimized equation:

Here,

X = ABC' + AB'C + ABC + AB'C'
    = ABC' + ABC + AB'
    = AB + AB' = A

Y = A'BC + A'BC' + AB'C + AB'C'
    = A'B + AB'C + AB'C'
    = A'B + AB'

Z = A'B'C + A'BC' + AB'C' + ABC

Circuit diagram:
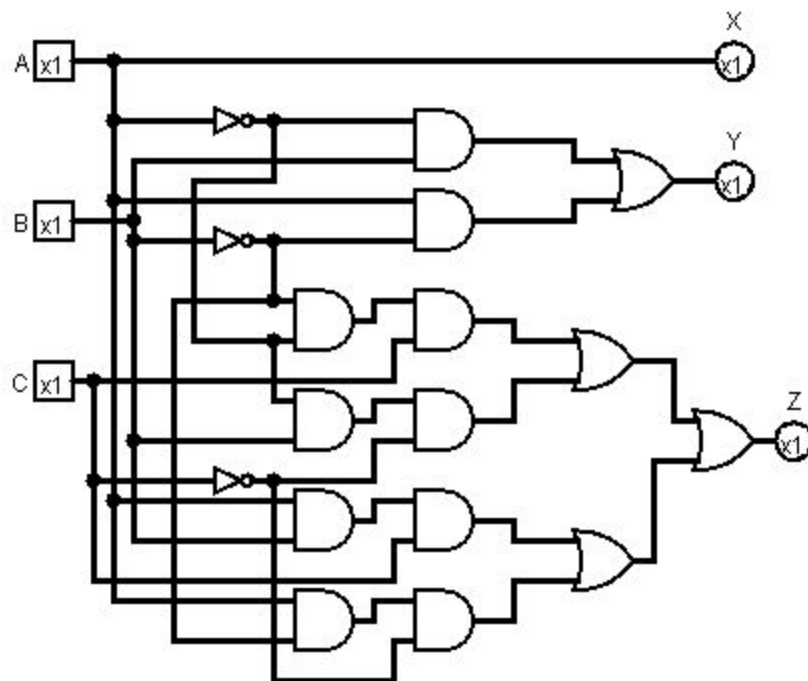
<u>Observation:</u> Here, we see that the first binary output equals the MSB of the gray code. Again, the second binary output is an equivalent of the X-OR gate.

Problem - 3

<u>Problem specification:</u>
Derive the truth table and corresponding output equations for the given condition and implement those with the required gates.

<u>Required instruments:</u>
(1) 3 input pins, (2) 2 output pins, (3) 1 IC7404 gate, (4) 3 IC7408 gates, (5) 2 IC7432 gates, (6) Wires.

<u>Truth table:</u>
We construct the following table following the inputs of A, B, and C and observe the output at X and Y as the LED. Each of the expressions for X and Y has been obtained by taking the sum of the input combinations for which the corresponding output is ON.

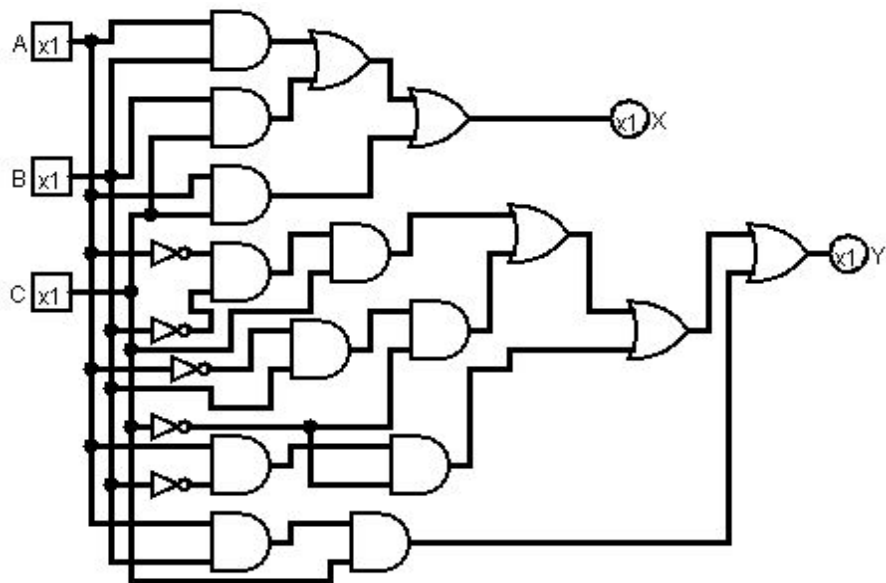| A	B	C	X	Y
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0

1	1	1	1	1

Minimized equation:

Here,

      X = A'BC + AB'C + ABC' + ABC

        = BC + AB'C + ABC'

        = C(B+AB') + ABC'

        = C(A+B) + ABC'

        = CA+ BC +ABC'

        = CA + B(C+AC')

        = AB + BC + CA

      Y = A'B'C + A'BC' + AB'C' + ABC

Circuit diagram:

Observation: The LED output X denoting the MSB of the pattern of input is a sum of the product of the inputs. Here, X denotes the MSB of the inputs' pattern and Y denotes the LSB of the inputs' pattern.

Problem - 4

<u>Problem specification:</u>
For the following logic function, find out the truth table, write down the logic expression.Simplify the logic expression as far as possible using Boolean algebra and then implement it.

F (A, B, C, D) = Σ(6, 9, 12, 15)

<u>Required instruments:</u>
(1) 4 input pins, (2) 1 output pin, (3) 1 IC7404 gate, (4) 3 IC7408 gates, (5) 1 IC7432 gate, (6) Wires.

<u>Truth table;</u>

We construct the following table following the inputs of A, B, C, and D and observe the output at Y. Here,
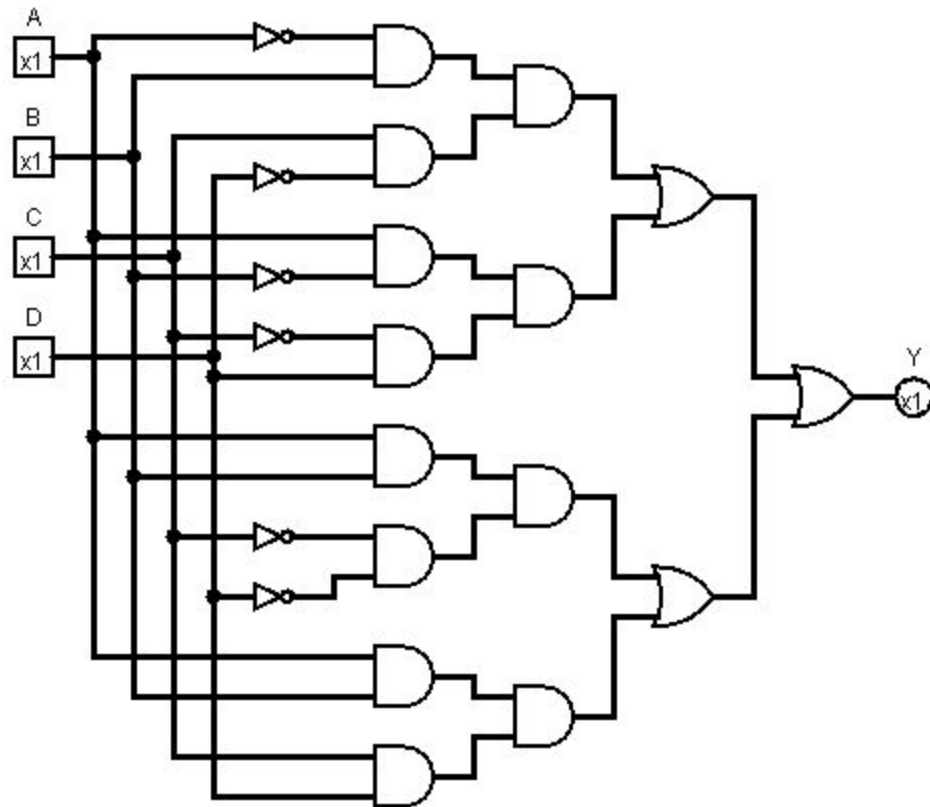
$$Y = A'BCD' + AB'C'D + ABC'D' + ABCD$$

The above expression for Y is obtained by taking into consideration only the summation of the input combinations which result in ON state of Y. And we see that the formulated expression is in fact the minimized equation.

A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0

0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Circuit diagram:

Observation: Here, the output Y is ON only for those input combinations where those combinations match the binary format of the numbers 6, 9, 12, and 15. Other than that, the output Y is OFF.