CSE 206 (Digital Logic Design Sessional)

Experiment No.: 02

Name of the Experiment:

Truth tables and simplification using Boolean Algebra

Group No.:	06
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Date of Performance:	10/03/2021
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Problem No.1:

Problem Specification:

Simplify the 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

Required Instruments:

No	Name	Model	Quantity
01	Logisim Software		
02	IC(Hex-Inverter)	74LS04	01
03	IC (Quad 2 input AND)	74LS08	01
04	IC (Quad 2 input OR)	74LS32	01
05	Wires		
06	Input Pins		04
07	Output Pins		01

Truth Table:

A	B	C	D	F (A, B, C, D)
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

Required Equation:

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

= A'B'C'D'+A'B'CD'+ABCD+ABC'D+A'BC'D+A'BCD+AB'C'D'+AB'CD'

= A'B'D'(C'+C)+ABD(C+C')+A'BD(C'+C)+AB'D'(C'+C)

= A'B'D'+ABD+A'BD'+AB'D'

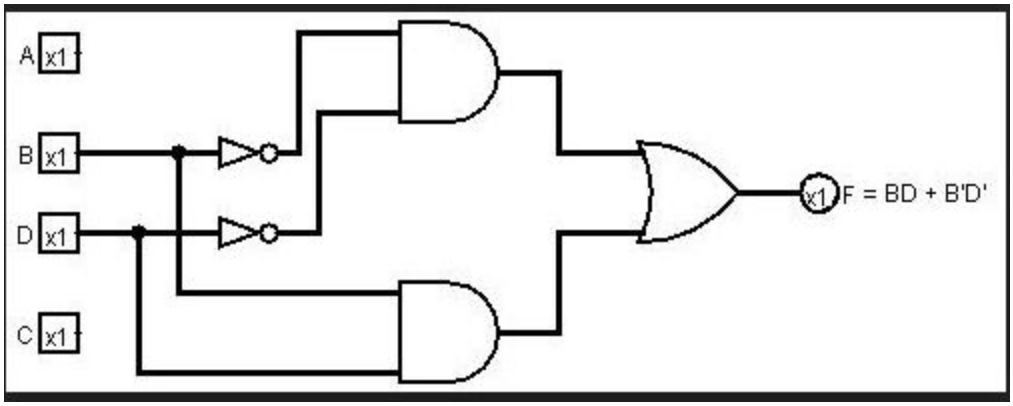
= A'B'D'+AB'D'+ABD+A'BD

= B'D'(A'+A)+BD(A+A')

= B'D'+BD

= (B ⊕ D)'

Circuit Diagram:



Observations:

1) We tried to make the circuit in such a way that it was not too dense with wires
2) We used the documentations of the ICs to make sure the connections were given through the right pins
3) We checked the output according to the truth table

Problem no.02

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:

No	Name	Model	Quantity
01	Logisim Software		
02	IC (Hex-Inverter)	74LS04	01
03	IC (Quad 2 input AND)	74LS08	03
04	IC (Quad 2 input OR)	74LS32	01

05	Wires		
06	Input Pin		03
07	Output Pin		03

Truth table:

Truth table for the 3-bit gray code to binary representation conversion is presented below. Here ABC is gray code and XYZ is its binary representation.

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

Required Equation:

Equation for X:

X = ABC’ + ABC + AB’C + AB’C’

= AB(C+C’) + AB’(C+C’)

= AB + AB’

= A(B+B’)

= A

Equation for Y:

Y = A’BC + A’BC’ + AB’C + AB’C’

= A’B (C + C’) + AB’ (C + C’)

= A’B + AB’

=A ⊕ B

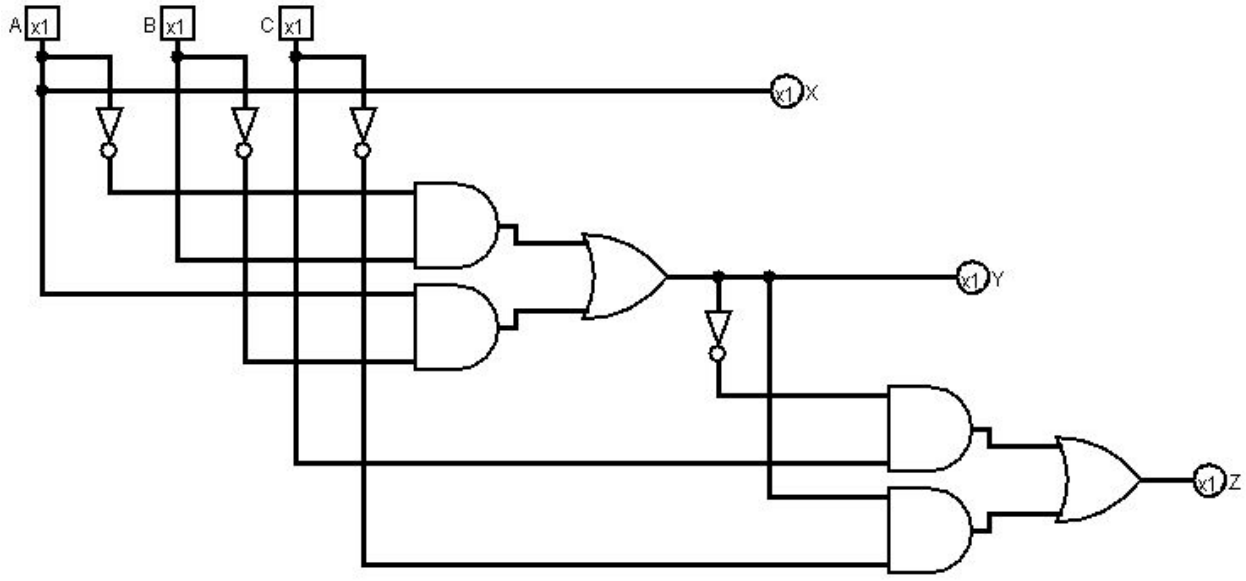
Equation for Z:

Z = A’B’C + A’BC’ + ABC + AB’C’

= A’ (B ⊕ C) + A (B ⊕ C)’

= A ⊕ (B ⊕ C)

<u>Circuit Diagram:</u>



Observation:

1) We made a truth table and found out the output equations. We simplified the output equations and implemented the simplified form in our diagram.
2) We tried to make the circuit in such a way that it was not too dense with wires.
3) We used the documentations of the ICs to make sure the connections were given through the right pins.
4) We checked the output according to the truth table.

Problem no.03

Problem specification:

Derive the truth table and corresponding output equations for the given condition and implement those with the required gates.

Condition: There are 3 inputs into a system. The system will glow LED1 and LED0 in such a way that the pattern represents the number of set bits in the input.

Required Instruments:

No	Name	Model	Quantity
01	Logisim Software		
02	IC (Hex-Inverter)	74LS04	01
03	IC (Quad 2 input AND)	74LS08	02
04	IC (Quad 2 input OR)	74LS32	01
05	Wires		
06	Input Pin		03

07	Output Pin		02

Truth Table:

A	B	C	LED1	LED0
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

Required Equation:

Equation for LED0:

LED0 = A'B'C + A'BC' + AB'C' + ABC

= A' (B $\oplus$ C) + A (B $\oplus$ C)'

= A $\oplus$ (B $\oplus$ C)

Equation for LED1:

LED1 = A'BC + AB'C + ABC' + ABC

= BC (A + A') + A (BC' + B'C)

= BC + AB'C +ABC'

= C (B + AB') + ABC'

= C (A+B) + ABC'

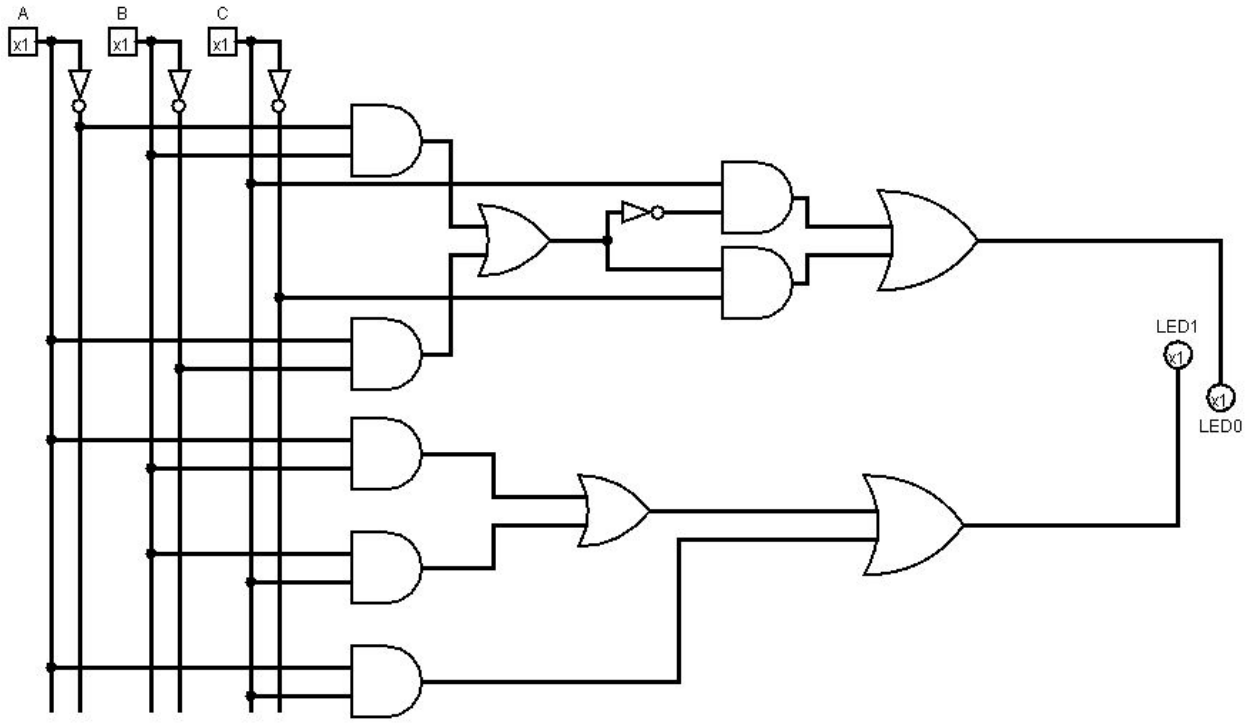
= AC + BC +ABC'

= BC + A (BC' + C)

= BC + A(B+C)

= AB + BC + AC

Circuit Diagram:



Observation:

1) We made a truth table and found out the output equations. We simplified the output equations and implemented the simplified form in our diagram.
2) We tried to make the circuit such a way that it was not too dense with wires

3) We used the documentations of the ICs to make sure the connections were given through the right pins.
4) We checked the output according to the truth table.

Problem No.4:

Problem Specification:

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)

Required Instruments:

No	Name	Model	Quantity
01	Logisim Software		
02	IC(Hex-Inverter)	74LS04	01
03	IC (Quad 2 input AND)	74LS08	02
04	IC (Quad 2 input OR)	74LS32	01
05	Wires		
06	Input Pins		04
07	Output Pins		01

Truth Table:

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

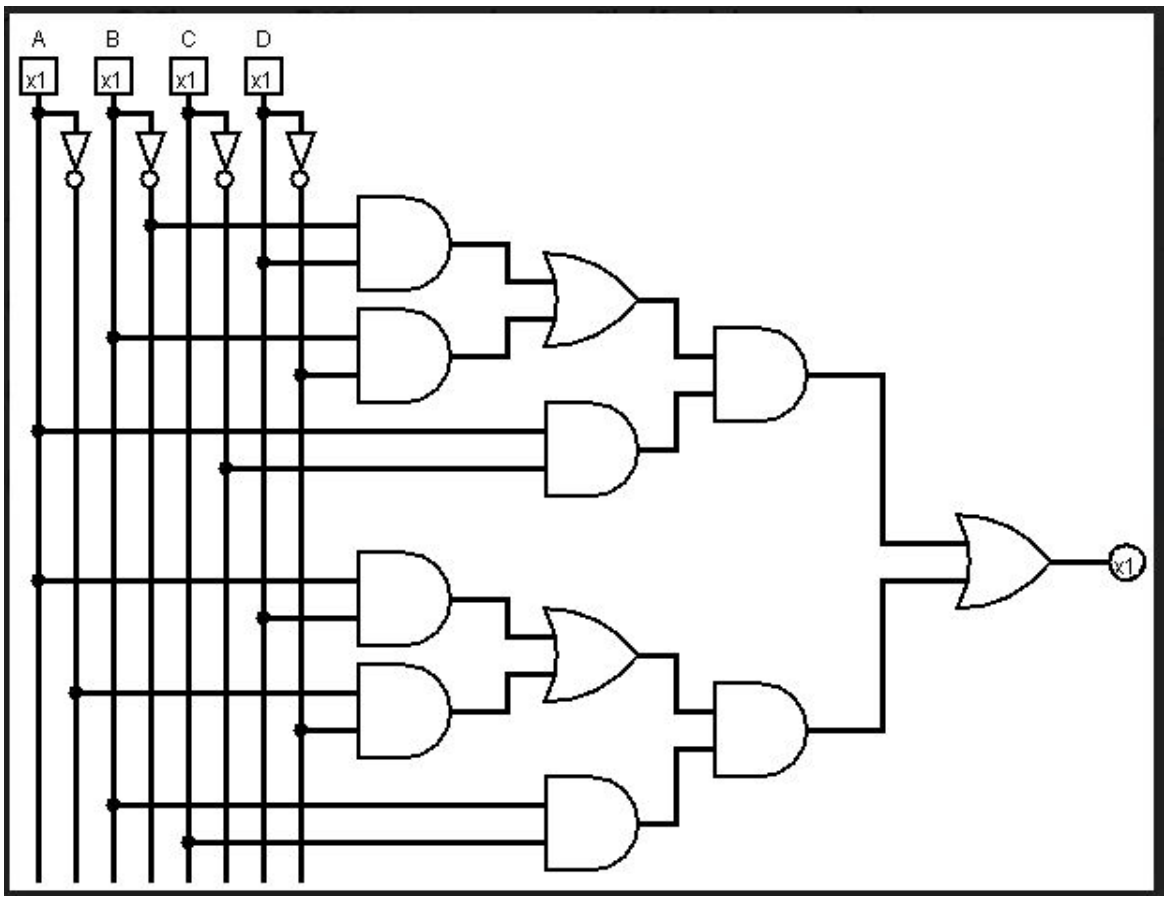
Required Equation:

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

= BC (AD + A'D') + AC' (B'D + BD')

= BC (A $\oplus$ D)' + AC' (B $\oplus$ D)

Circuit Diagram:



Observations:

1) We tried to make the circuit in such a way that it was not too dense with wires
2) We used the documentations of the ICs to make sure the connections were given through the right pins
3) We checked the output according to the truth table