

CSE 206 (Digital Logic Design Sessional)

Experiment No.: 02

Name of the Experiment:

**Truth tables and simplification using Boolean Algebra**

Group No.:	06
Writers' Roll:	1805116 1805120
Section:	B2
Department:	CSE
Other Group Members:	1805117 1805118 1805119 1705107
Date of Performance:	10/03/2021
Date of Submission:	13/03/2021

**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:**

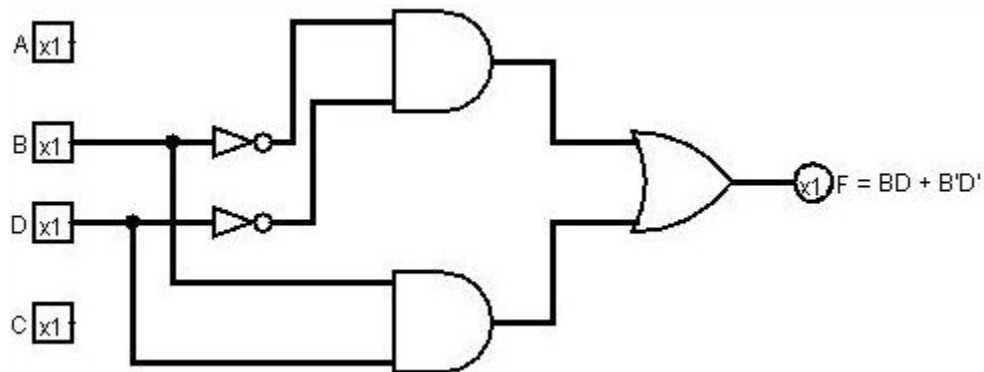
A	B	C	D	F (A, B, C, D)
0	0	0	0	1
0	0	0	1	0

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:**

$$\begin{aligned}
 F(A, B, C, D) &= A'B'C'D' + ABCD + ABC'D + A'B'CD' + A'BC'D + AB'C'D' + AB'CD' + A'BCD \\
 &= A'B'C'D' + A'B'CD' + ABCD + ABC'D + A'BC'D + A'BCD + AB'C'D' + AB'CD' \\
 &= A'B'D'(C' + C) + ABD(C + C') + A'BD(C' + C) + AB'D'(C' + C) \\
 &= A'B'D' + ABD + A'BD' + AB'D' \\
 &= A'B'D' + AB'D' + ABD + A'BD \\
 &= B'D'(A' + A) + BD(A + A') \\
 &= B'D' + BD \\
 &= (B \oplus D)'
 \end{aligned}$$

### 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:**

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

$$= A'B(C+C') + AB'(C+C')$$

$$= A'B + AB'$$

$$= A \oplus B$$

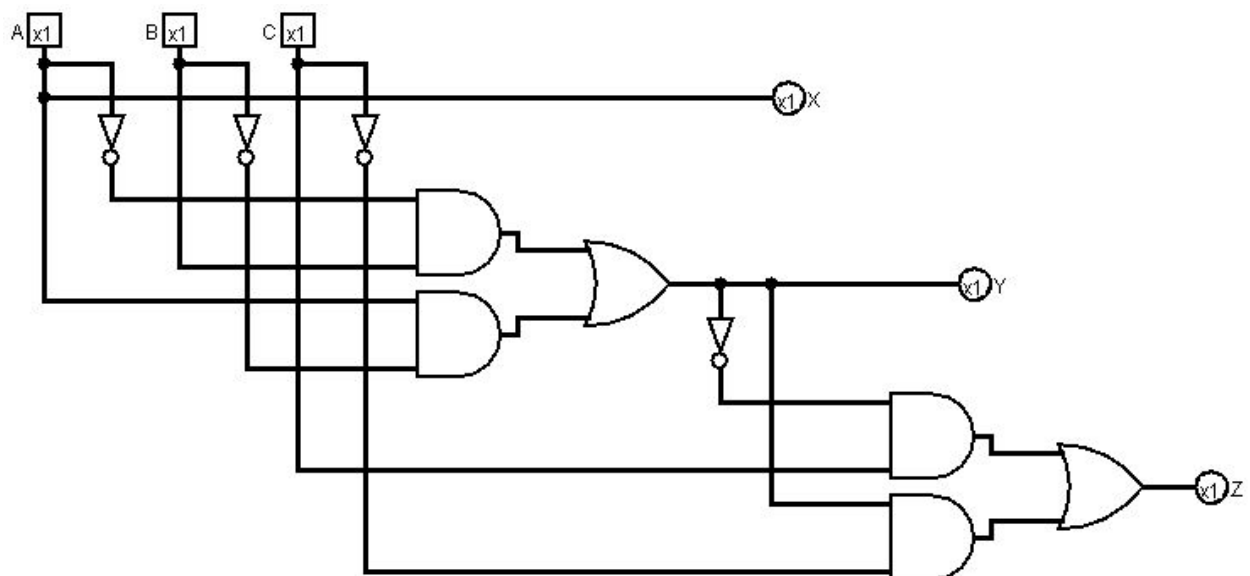
**Equation for Z:**

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

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

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

**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 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:**

$$\text{LED0} = A'B'C + A'BC' + AB'C' + ABC$$

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

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

**Equation for LED1:**



$$\text{LED1} = A'BC + AB'C + ABC' + ABC$$

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

$$= BC + AB'C + ABC'$$

$$= C(B + AB') + ABC'$$

$$= C(A+B) + ABC'$$

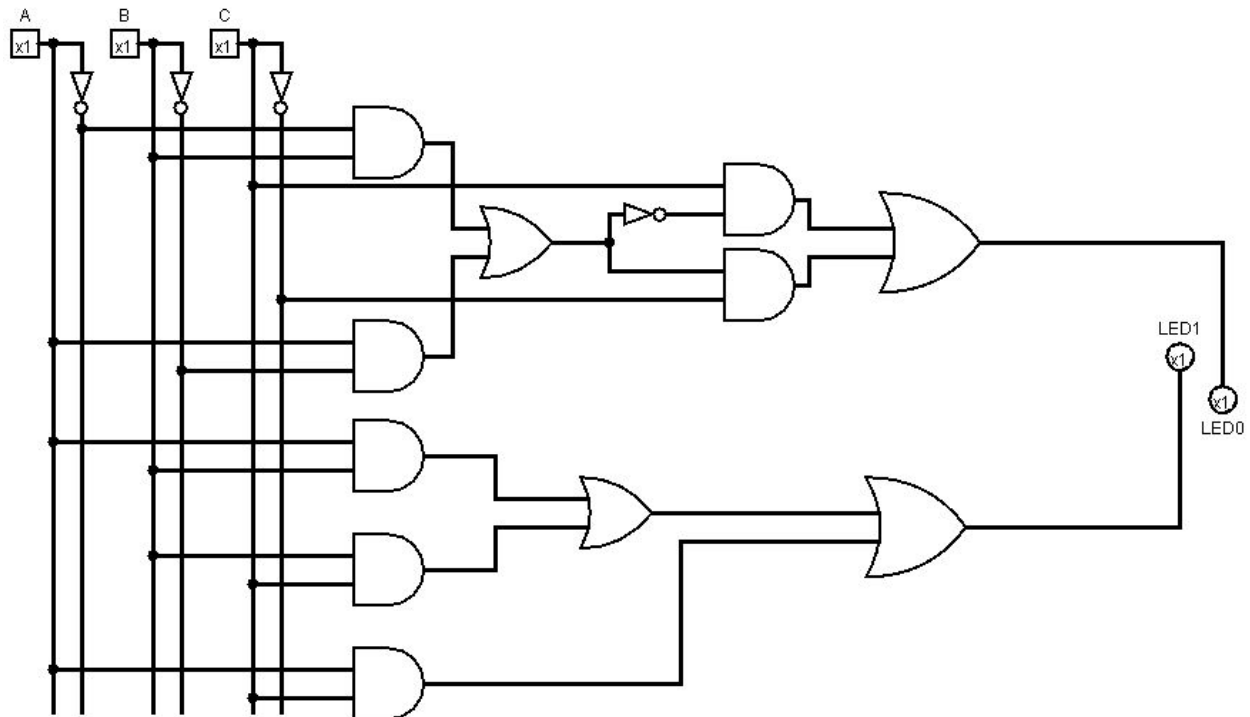
$$= AC + BC + ABC'$$

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

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

$$= AB + BC + AC$$

### 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.  
 $F(A, B, C, D) = \Sigma(6, 9, 12, 15)$

##### **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

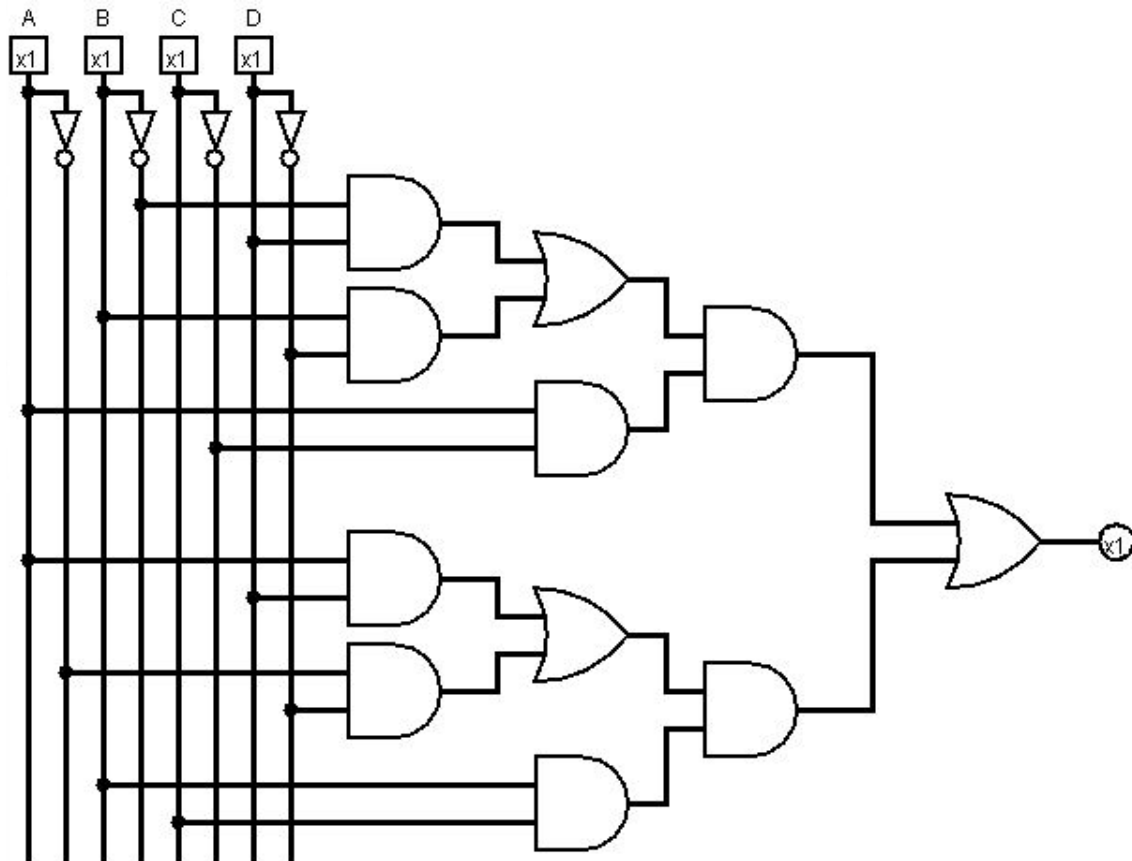
**Truth Table:**

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:**

$$\begin{aligned}F(A, B, C, D) &= A'BCD' + AB'C'D + ABC'D' + ABCD \\&= BC(AD + A'D') + AC'(B'D + BD') \\&= BC(A \oplus D)' + AC'(B \oplus D)\end{aligned}$$

### 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