USTHB FI 2024-2025
1st Year Computer Science. **Series N°2**
Module: STRM1

Exercise 1 :

1. Establish the truth tables for the following functions:
   - ✓ $F1 = (X + Y)(\bar{X} + Y + Z)$
   - ✓ $F2 = (\bar{X}Y + X\bar{Y})\bar{Z} + (\bar{X}\bar{Y} + XY)Z$
2. Demonstrate the following equivalences using truth tables:
   $X + YZ = (X+Y)(X+Z)$
   $(\bar{X} + Y)(X + Z)(Y + Z) = (\bar{X} + Y)(X + Z)$

Exercise 2 :

1. Simplify the following expressions algebraically:
   - ✓ $(x + \bar{y} + x\bar{y})(xy + \bar{x}z + yz)$
   - ✓ $a + \bar{a}b + \bar{a}\bar{b}c + \bar{a}\bar{b}\bar{c}d + \bar{a}\bar{b}\bar{c}\bar{d}e$
   - ✓ $abcd + abchg + \bar{d}hg + abcdefh.$
   - ✓ $a\bar{c}de + \bar{d} + \bar{e} + c$
2. Prove the following equality algebraically:
   - ✓ $A\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + \bar{A}\bar{B}C\bar{D} = \bar{A}\bar{C}\bar{D} + \bar{B}$
   - ✓ $A.B + \bar{A}.C + B.C = A.B + \bar{A}.C$
   - ✓ $AB + ACD + \bar{B}D = AB + \bar{B}D$

Exercise 3 :

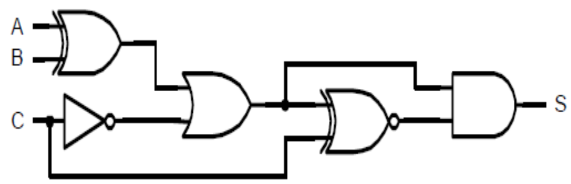
Simplify using De Morgan's theorem:

$$S = \overline{(x + \overline{y + z})(x + \overline{\bar{y}\,\bar{z}})} + \bar{x}\,\bar{y}(\bar{z}t + tz)$$

$$T = \overline{\overline{(a\,\bar{b})}\,(\overline{\overline{b + c + \bar{d}}}) + \overline{bc}}$$

Exercise 4

1. Draw up the truth table for the circuit below.
2. Extract the equation of S from the truth table.



Exercise 5 :

Simplify the functions given by the Karnaugh maps. Create circuits using only NAND gates, then only NOR gates:

cd \ ab	00	01	11	10
00	1	1	1	
01		1	1	
11		1	1	
10	1	1	1	1

cd \ ab	00	01	11	10
00	1			1
01	1	1		1
11		1	1	
10	1		1	1

cd \ ab	00	01	11	10
00	1			1
01	X	1	1	1
11	X	1	1	X
10	X	1	1	

cd \ ab	00	01	11	10
00	1	1		1
01	1	1	X	1
11	1	1		1
10	X	X		

Exercise 6 :

Use the Karnaugh maps to simplify the following functions, then create the corresponding circuits using NOR or NAND gates.

$F(a, b, c) = \Pi(0, 1, 2, 3, 4, 7)$; $G(a, b, c, d) = \sum(2, 6, 7, 10, 11, 12, 14)$

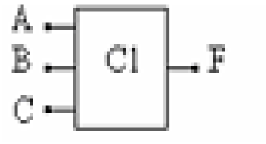
Exercise 7 :

1. Let F be a function consisting only of NOR functions:

$$F=\overline{\overline{(x+y+z)}+(\overline{x+y+\bar{z}})+\overline{\bar{x}+y+z)}}$$

Give the truth table, the first canonical form and the corresponding function composed only of NAND.

2. Let F(A,B,C) be a function defined as follows:



- F(A,B,C) = 1 if $(ABC)_2$ contains an odd number of 1's;
- F(A,B,C) = 0 else.

a) Establish the truth table for F.
b) Give the algebraic equation of F.
c) Draw the C1 circuit diagram of function F with the minimum number of logic gates.

Extra exercises

Exercise 8

1. Simplify the following expressions algebraically:

✓ $(A \oplus B \oplus C) + \overline{ABC}$
✓ $AB\bar{C}\bar{D} + A\bar{B}CD + ABCD + ABC\bar{D} + \bar{A}B\bar{C}D + \bar{A}BCD$

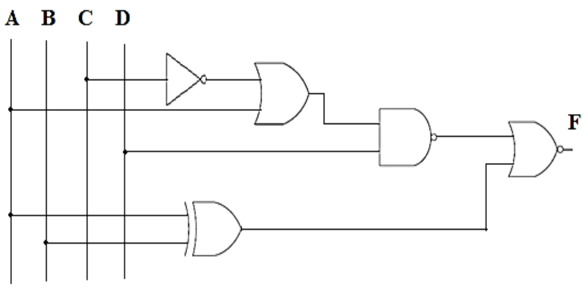
2. Prove the following equality algebraically:

✓ $AB + AC + BC \quad = \quad (A+B)(A+C)(B+C)$
✓ $(X\bar{Z} + YZ) \oplus (X\bar{Y} + YZ) = X(Y \oplus Z)$

Exercise 9:

Let the following circuit:

1. Extract the expression of F.
2. By **the algebraic method**: Give the simplified function of F.
3. Draw the logic circuit of F using only NAND gates.



Exercise 10

Consider the following logic circuit:

1. Study the output Y by establishing its truth table:
2. Calculate the simplified disjunctive form of the function Y using Karnaugh map.
3. Calculate the simplified conjunctive form of the function Y using Karnaugh map.
4. Draw the new simplified circuit of Y (disjunctive form) using NAND gates