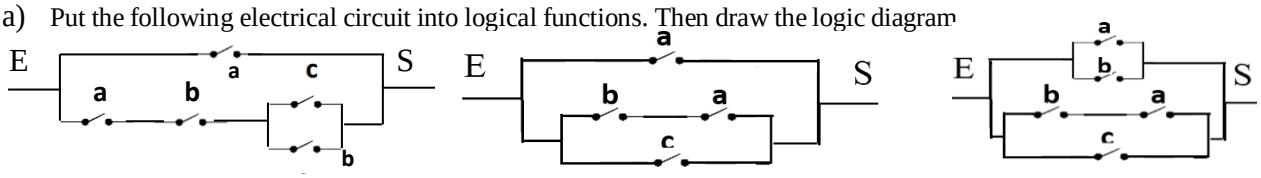
Machine Structure 1 : Work Sheet N°03

Exercise 01:

- Give the hexadecimal representation using the floating point with the IEEE754-SP (32bits) standard, the following numbers: $A=(54,25)_{10}$, $B=(-103,390625)_{10}$
- Represent in the form $\pm a \cdot 2^b$ (a and b are decimal) using the floating point IEEE754-SP (32bits) standard, the following numbers:
  $X = (C1580000)_{16}$, $Y = (41F00000)_{16}$
- Give the hexadecimal representation using the floating point with the IEEE754-SP (32bits) of the sum : X+Y

Exercise 02:

a) Put the following electrical circuit into logical functions. Then draw the logic diagram



b) Put the following texts into logical functions. After, draw the truth table and the logic diagram of each function.

1. A padlock *(P)* with three keys (x, y and z), each key with two positions (open or closed), the padlock is open if at least two keys are open, and closed otherwise.
2. A lamp (L_1) with three switches (*A,B,C*), each switch with two states (ON or OFF), the lamp is out if all switches are ON or if the 1st and 3rd are ON, and it is lit in other cases.
3. A four-switch lamp (S_1,S_2,S_3,S_4) each switch in two states (0 or 1), the lamp (L_2) is lit if all the odd- numbered switches are 1 and the even-numbered switches are 0, and it is out in all other cases.

Exercise 03:

A. Draw the truth table and the logic diagram of the following functions.

F1=$(a + bc)(a\bar{c} + d)(a\bar{b}d + \bar{c}d)$

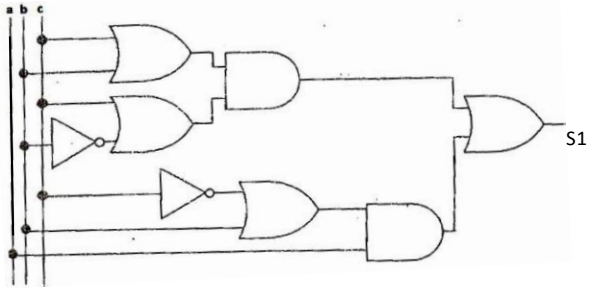
F2 = $(\overline{a\bar{b}} + \bar{d})(a + \bar{c})(\bar{b}c + \bar{a}b + ad)$

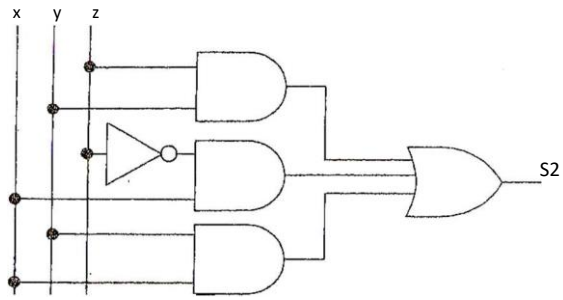
F3 = $(a\bar{b} + \bar{c})(\bar{b}c + a)(b + \bar{a}c)(a\bar{c} + \bar{b})$

F4 = $(a + \bar{b})(a\bar{b} + b)(\bar{a} + \bar{b})$

F5 = $(a\bar{c} + \bar{b}d)(ac\bar{b}d + b\bar{c}d)(\bar{a}b\bar{d} + \bar{b}c\bar{d})$

B. Give the corresponding functions then draw the truth table of these logic diagrams.





C. Rewrite the functions F1 to F5 of the first question by using only the NAND gate, then by using only the NOR gates.

Exercise 04:

1. Prove the following theorems and axioms:

1- $(A.B)+(A.B')=A$, $B' = \bar{B}$

2- $A(A'+B)=AB$, $A' = \bar{A}$

3- $(A+B)(A'+C)(B+C)=(A+B)(A'+C)$, $A' = \bar{A}$

4- $(A+B)(A+B'+C)=(A+B)(A+C)$, $B' = \bar{B}$

5- $A.(A+B)=A$

6- $A+A'B=A+B$, $A' = \bar{A}$

7- $AB+A'C+BC=AB+A'C$, $A' = \bar{A}$

8- $AB+AB'C=AB+AC$, $B' = \bar{B}$

9- $A+(A.B)=A$

10-$(A+B)(A+B')=A$, $B'=\bar{B}$

2. Develop and simplify the following functions:

1- $F_1 = (a + b)(ab + ac)(a' c' + b)$

2- $F2=(a + c)(b + d)$

3- $F3=(a + c + d)(b + c + d)$

4- $F4=(ab' + c + cd)(a'c' + bc + d))$

5- $F_5 = ab(ab'c + a(bc)' + (abc)')$, $b' = \bar{b}$, $(bc)' = \overline{bc}$, $(abc)' = \overline{abc}$

quick fix

ex01:

- A=(54.25)10→**$(42590000)_{16}$** , **B=(**−103.390625)10→**$(C2CEC800)_{16}$**
- *X*=**$-1.6875\times2^3 = (-13.5)_{10}$** , *Y*=**$1.875\times2^4=(30)_{10}$**
- *X*+*Y*→**$(41840000)_{16}$**

ex02:

a. *S1=A+A.B.(C+B)* *S2=A+((A.B)+C)* *S3=A+((A+B)+C)*

b. $P=x.y+y.z+x.z+x.y.z$, $L_1 = \overline{(A.B.C) + (A \cdot C)} = \bar{A} + \bar{C}$, $L_2 = S1.\overline{S2}.S3.\overline{S4}$

ex03:

A. $F_1=\sum m(9,10,11,13)$, $F_2=\sum m(4,10)$, $F_3=\sum m(12,13)$, $F_4=\sum m(8,9,10,11)$, $F_5=0$

B. $S_1 = (b + c).(\bar{b} + c) + a.(b + \bar{c})$, $S_2 = y.z + x.\bar{z} + x.y$

C. **NAND-only** & **NOR-only** implementation :

a. NAND-only implementation : $F_1 = \overline{\overline{a.b.b.d}.\overline{a.c.c.d}}$, $F_4 = \overline{\overline{a.b.b}}$

b. NOR-only implementation : $F_1 = \overline{\overline{\overline{a+a}+\overline{d+d}}+\overline{\overline{b+b}+\overline{c+c}}}$, $F_4 = \overline{\overline{a+b+b}}$

ex04:

1-*Prove the following theorems and axioms:*

1- $A\cdot B+A\cdot B'= A\cdot(B+B')= A\cdot1=A$

2- $A\cdot(A'+B)=A\cdot A'+A\cdot B= 0+A\cdot B=A\cdot B$

3- $(A+B)(A'+C)(B+C)=(0+AC+A'B+BC)(B+C)= ACB+ACC+A'BB+A'BC+BCB+BCC$
$=ABC+AC+A'B+A'BC+(BC+BC) =AC(B+1)+A'B(C+1)+BC=AC+A'B+BC$, *which is same as* $(A+B)(A'+C)$

4- $(A+B)(A+B'+C)= (A+B)((A+C)+B')=(A+B)(A+C)+(A+B)B'= (A+B)(A+C)+AB'+BB'=(A+B)(A+C)+AB'+0$
$=(A+B)(A+C)+AB' = AA +BC+AC+AB'= A +BC+AC+AB'= (C+1)A +BC+AB'= A+BC+AB'=A(1+B')+BC=A+BC$
$=(A+B)(A+C)$

5- $A\cdot(A+B)=A\cdot A+A\cdot B= A+A\cdot B=A(1+B)=A\cdot1=A$

6- $A+A'B=(A+A')(A+B) = 1\cdot(A+B)=A+B$

7- $AB+A'C+BC= AB+A'C+BC.1= AB+A'C+BC(A+A')= AB+A'C+ABC+A'BC= AB(1+C)+ A'C(1+B)=AB+A'C$

8- $AB+AB'C=A(B+B'C)=A(B+B')(B+C)=A(B+C)=AB+AC$

9- $A+(A\cdot B)=A(1+B)=A\cdot1=A$

10- $(A+B)(A+B')=A+BB'= A+0=A$

2- Develop and simplify the following functions:

1- $F_1 = (a + b)(ab + ac)(a' c' + b)=ab$

2- $F2=(a + c)(b + d)=ab+ad+bc+cd$

3- $F_3=(a + c + d)(b + c + d) =ab+c+d$

4- $F_4=(ab' + c + cd)(a'c' + bc + d)) = ab'd + bc + cd$

5- $F_5 = ab(ab'c + a(bc)' + (abc)')=abc'$