Correction of the final exam.
STRM1. (S1/24/25)

Exercice 1:

1.1. $A = (42)_{10} = (?)_2 = (?)_8$ 0,25.

$A = (42)_{10} = (101010)_2 = (52)_8$ 0,25 0,25

$B = (1101010)_G = (?)_2 = (?)_8$

$$\begin{matrix} 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ G_7 & G_6 & G_5 & G_4 & G_3 & G_2 & G_1 \end{matrix}$$

$B_7 = G_7 = 1$
$B_6 = G_6 \oplus B_7 = 0$
$B_5 = G_5 \oplus B_6 = 0$
$B_4 = G_4 \oplus B_5 = 1$
$B_3 = G_3 \oplus B_4 = 1.$
$B_2 = G_2 \oplus B_3 = 0$
$B_1 = G_1 \oplus B_2 = 0.$

$B = (1001100)_2 = (?)_8$ 0,25

$\underbrace{1}_{1}\underbrace{001}_{1}\underbrace{100}_{4}$

$B = (114)_8$ 0,25

$C = (000100000011)_{BCD} = (?)_2 = (?)_8$

$C = (?)_{10}$ 0,25 $\underbrace{0001}_{1}\underbrace{0000}_{0}\underbrace{0011}_{3}$

$C = (103)_{10} = (?)_2.$

$$\begin{array}{l} 103 \div 2 = 51 \text{ r } 1 \\ 51 \div 2 = 25 \text{ r } 1 \\ 25 \div 2 = 12 \text{ r } 1 \\ 12 \div 2 = 6 \text{ r } 0 \\ 6 \div 2 = 3 \text{ r } 0 \\ 3 \div 2 = 1 \text{ r } 1 \\ 1 \div 2 = 0 \text{ r } 1 \end{array}$$

$C = (1100111)_2 = (147)_8.$ 0,25.

1.2 $S_1 = A + C$

$A = (101010)_2 = (00101010)_2 = (00101010)_{C_2}$ 0,25

$C = (1100111)_2 = (01100111)_2 = (01100111)_{C_2}$

bit sign

$A + C = 00101010 + 01100111 = ?$

$$\begin{array}{r} 00101010 \\ +\ 01100111 \\ \hline 10010001 \end{array}$$ 0,5

$(+) + (+) = (-) \Rightarrow$ overflow. 0,25

$S_2 = -A - B = ?$

$-A-B = (-A)_{C_2} + (-B)_{C_2} = ?$

$A = 101010 = (00101010)_2 \Rightarrow -A = (10101010)_2 = (?)_{C_2}$.

bit sign

$|1010101 0| = 0101010$.

$(0101010)'' = 1010101 + 1 = 1010110$ 0,25

$(-A)_{C_2} = (11010110)_{C_2}$.

$B = 1001100 = (01001100)_2 \Rightarrow -B = (11001100)_2 = (?)_{C_2}$.

bit sign

$|1100 1100| = 1001100$

$(1001100)'' = 0110011 + 1 = 0110100$ 0,25

$(-B)_{C_2} = (10110100)_{C_2}$.

$(-A)_{C_2} + (-B)_{C_2} = ?$

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   1 1  1   1
   1 1 0 1 0 1 1 0      0,25
 + 1 0 1 1 0 1 0 0
 -----------------
 1 1 0 0 0 1 0 1 0
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rejected

$(-) + (-) = (-)$ 0,25

$\Rightarrow$ No overflow.

2) ASCII code of the word 'EXAM'.

E X A M.

$(45)_{16} (58)_{16} (41)_{16} (4D)_{16}$

So, EXAM = 4558414D. 1

3) $N_1 = 41DC0000$

$N_1 = (?)_{10}$

$N_1 = $ | 0 | 100 0001 1 | 101.1100 0000 0000 0000 0000 | 0,25

bit sign, exp, M.

$exp_B = 10000011 = (131)_{10} \Rightarrow exp_r = 131 - 127 = 4$. 0,25

$N_1 = 1,10111 \times 2^4 = 11011,1 = 1.2^4 + 1.2^3 + 1.2 + 1.2^0 + 1.2^{-1}$

$= (27,5)_{10}$ 0,25

$N_2 = (?)_{10}$

$N_2 = C1480000$

$N_2 = (?)_{10}$

$N_2 =$ | 1 | 10000010 | 10010000 . . . . 0 | (0,25)

$exp_B = 10000010 = (130)_{10} \Rightarrow exp_r = 130 - 127 = 3.$ (0,25)

$N_2 = -1,1001 \times 2^3 = -1100,1 = -(1.2^3 + 1.2^2 + 1.2^{-1}) = (-12,5)_{10}$ (0,25)

3.2. $S = N_1 + N_2 = ?$

$S = 1,10111 \times 2^4 - 1,1001 \times 2^3 = (11,0111 - 1,1001) \times 2^3$

$$\begin{array}{r} 11,0111 \\ -\ 1,1001 \\ \hline 01,1110 \end{array}$$

(0,5)

$S = 1,111 \times 2^3 = ?$ condensed form in Hexadecimal ?

$exp = 3 \Rightarrow exp_B = 127 + 3 = (130)_{10} = (10000010)_2.$

$M = 111.$

$S =$ | 0 | 10000010 | 1110 . . . . . . 0 | (0,5)

$S = 41700000.$

Exercise 2 :

1) 1.1 Expression for F.

$F = (a \oplus b) + \overline{(c \oplus d)} + (a.c.d) + (\bar{a}.c.d) + (a\bar{b}\bar{c}) + (a.c.\bar{b})$ (1,25)

1.2. Simplification :

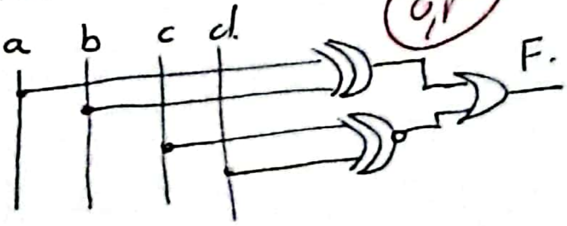
$F = \bar{a}b + a\bar{b} + \bar{c}\bar{d} + cd + acd + \bar{a}cd + a\bar{b}\bar{c} + ac\bar{b}$

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

$= \bar{a}b + a\bar{b} + \bar{c}\bar{d} + cd + \cancel{cd + a\bar{b}}.$

$\boxed{F = a \oplus b + \overline{c \oplus d}}$ (1,25)

1.3 circuit



(0,5)

2) $S = (a+b+c)(\bar{a}+b+c) + ab + bc$

2.1) Truth Table

a	b	c	s
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1.

1

2.2)

s: a \ bc	00	01	11	10
0	0	1	1	1
1	0	1	1	1

$\boxed{S = b + c}$.

1

2.3) s ~~with~~ using algebraic methode:

$$S = ab + ac + b\bar{a} + c\bar{a} + cb + c + \cancel{ab} + \cancel{bc}.$$

$$= c(a+\bar{a}) + b(a+\bar{a}) + c(b+1)$$

$$= c + b + c = \boxed{b + c}$$

1

Exercise 3.:

1) Truth table:

A	B	C	D	S_2	S_1	S_0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	1	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	0	0	1
1	0	0	1	0	1	0
1	0	1	0	0	1	0
1	0	1	1	0	1.	1
1	1	0	0	0	1	0
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1.	1.	0.	0

1

2) Simplified disjunctive equations of S_2, S_1 and S_0.

$\boxed{S_2 = ABCD}$.

0,25

$S_1 = ?$

S_1: AB \ CD	00	01	11	10
00			1	
01		1	1	1
11	1	1		1.
10		1	1	1.

0,5

$$S_1 = AB\bar{D} + \bar{B}CD + \bar{A}BD + A\bar{B}D$$
$$+ BC\bar{D} + A\bar{B}C.$$

$S_0 = ?$

AB \ CD	00	01	11	10
00		1		1
01	1		1	
11		1.		1.
10	1		1	

0,5

$$S_0 = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}BCD.$$
$$+ AB\bar{C}D + ABC\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}CD.$$

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3) S_0 with XOR !

$$S_0 = \bar A\bar B(\bar C D + C\bar D) + \bar A B(CD + \bar C\bar D) + AB(\bar C D + C\bar D) + A\bar B(\bar C\bar D + CD)$$

$$S_0 = \bar A\bar B(C\oplus D) + \bar A B(\overline{C\oplus D}) + AB(C\oplus D) + A\bar B(\overline{C\oplus D})$$

$$S_0 = (C\oplus D)(\bar A\bar B + AB) + (\overline{C\oplus D})(\bar A B + A\bar B)$$

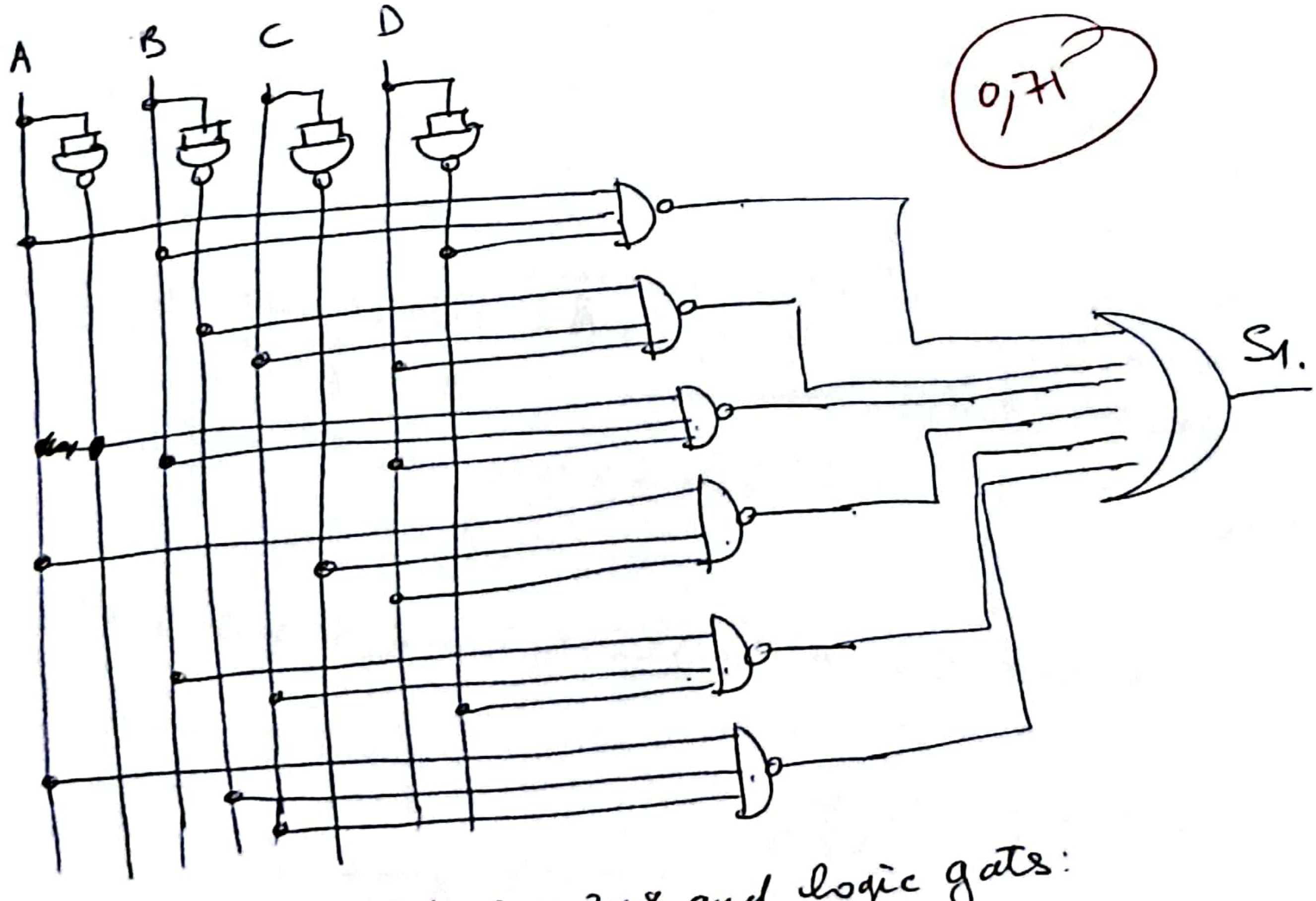
$$= (C\oplus D)(\overline{A\oplus B}) + (\overline{C\oplus D})(A\oplus B)$$ 1

$$\boxed{S_0 = (C\oplus D)\oplus(A\oplus B)}$$

4). S_1 circuit with only NAND gates:

$$S_1 = \overline{\overline{S_1}} = \overline{\overline{AB\bar D}\cdot\overline{\bar B C D}\cdot\overline{\bar A B D}\cdot\overline{A\bar C D}\cdot\overline{BC\bar D}\cdot\overline{A\bar B C}}$$

0,75

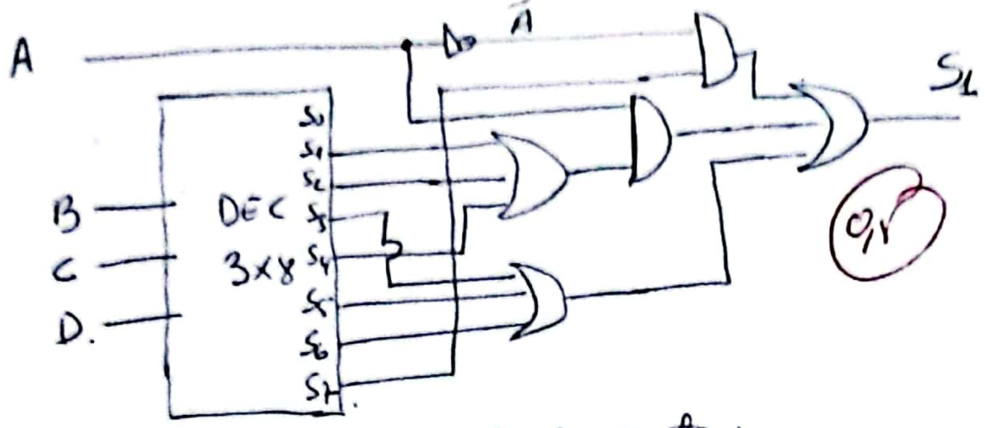


5) S_1 circuit with DEC 3x8 and logic gates:

$$S_1 = A[B\cancel{C\bar D} + B\bar C\bar D + B\cancel{\bar C D} + \bar B\bar C D + \bar B\cancel{CD} + \bar B C\bar D] + BC\bar D + \bar B C D$$
$$+ \bar A[BCD + B\bar C D]$$

0,5

$$= A[\underset{S_4}{\underset{100}{B\bar C\bar D}} + \underset{S_1}{\underset{001}{\bar B\bar C D}} + \underset{S_2}{\underset{010}{\bar B C\bar D}}] + \underset{S_6}{\underset{110}{BC\bar D}} + \underset{S_3}{\underset{011}{\bar B C D}} + \underset{S_7}{\underset{111}{\bar A BCD}} + \underset{S_5}{\underset{101}{B\bar C D}}.$$

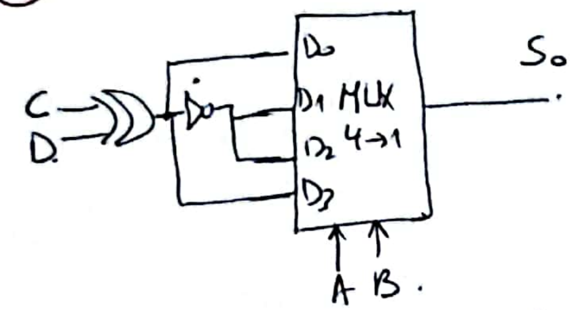


0,5

6) S_0 with a MUX 4x1 and logic gates:

$$S_0 = \underbrace{\bar A \bar B}_{00} \underbrace{(C \oplus D)}_{D_0} + \underbrace{\bar A B}_{01} \underbrace{(\overline{C \oplus D})}_{D_1} + \underbrace{A \bar B}_{10} \underbrace{(\overline{C \oplus D})}_{D_2} + \underbrace{AB}_{11} \underbrace{(C \oplus D)}_{D_3}$$

0,5

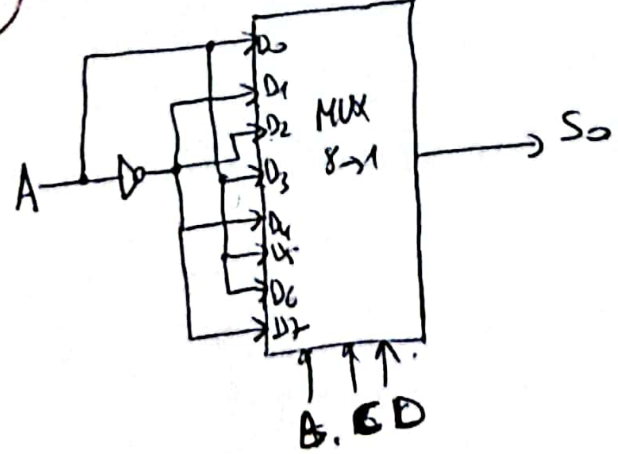


0,5

7) S_0 with a MUX 8x1 and inverters

$$S_0 = \bar A \left[\underbrace{\bar B \bar C D}_{001} + \underbrace{\bar B C \bar D}_{010} + \underbrace{B \bar C \bar D}_{100} + \underbrace{BCD}_{111} \right] + A \left[\underbrace{B \bar C D}_{101} + \underbrace{B C \bar D}_{110} + \underbrace{\bar B \bar C \bar D}_{000} + \underbrace{\bar B C D}_{011} \right]$$

0,5



0,5

Remark:

the same result can be obtained directly from the analysis of the truth table.

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