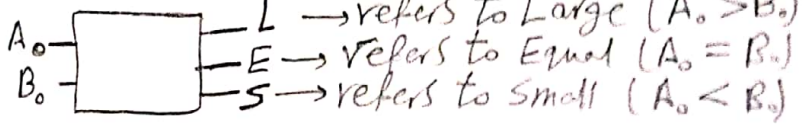
Name: Karim Mahmoud Kamal Mohamed
ID: 9203076
Sec: 2
B.N: 10

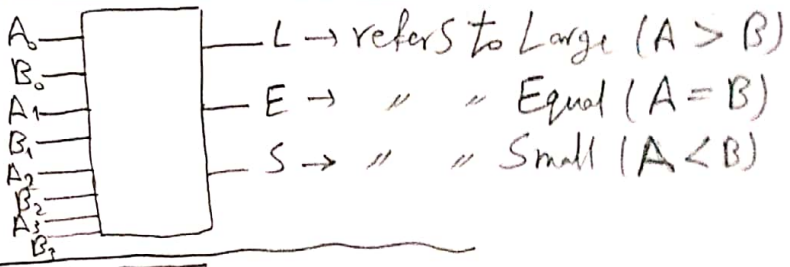
Work done in the project: I done all the Project alone.

Block Diagram:

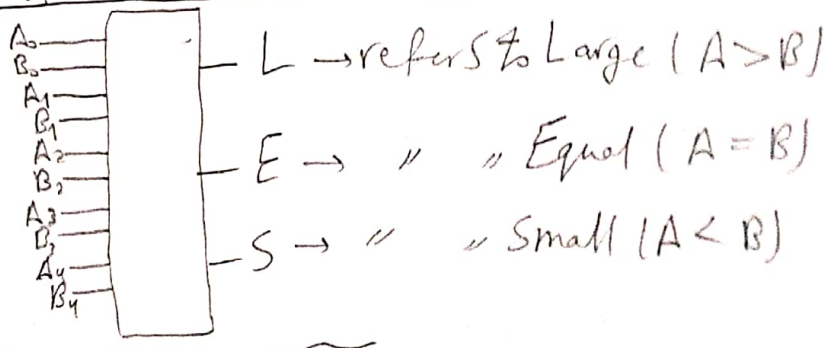
* 1-Bit Comparator:



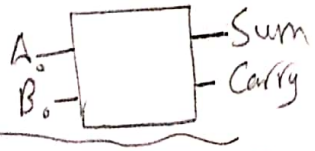
* 4-Bit Comparator:



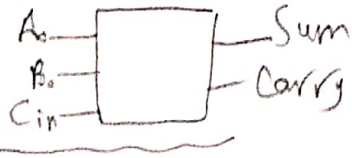
* 5-Bit Comparator:



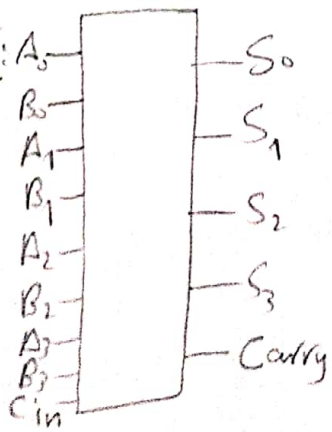
* Half Adder:



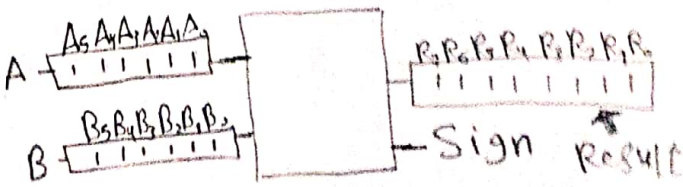
* Full Adder:



* 4-Bit Adder:

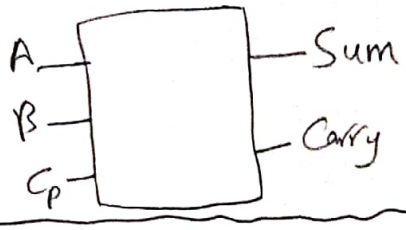


* Final_Adder:

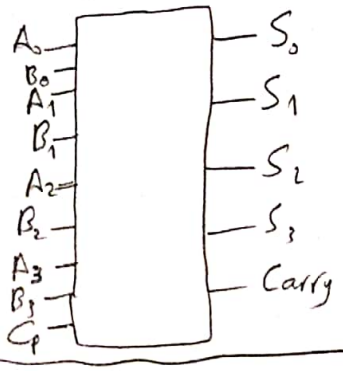


NoTe: A_5 → Sign of A
B_5 → Sign of B
R_5, R_6, R_7 → always will be Zeros

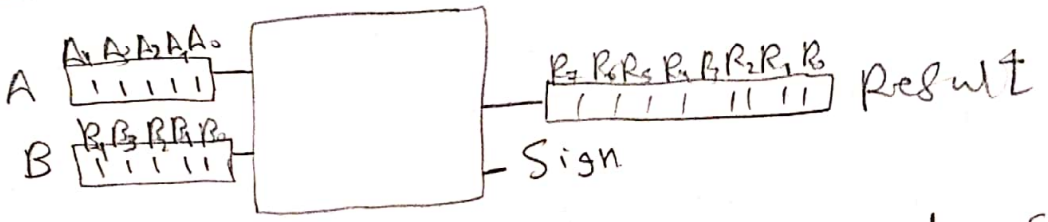
* Full Subtractor:



* 4-Bit Subtractor:

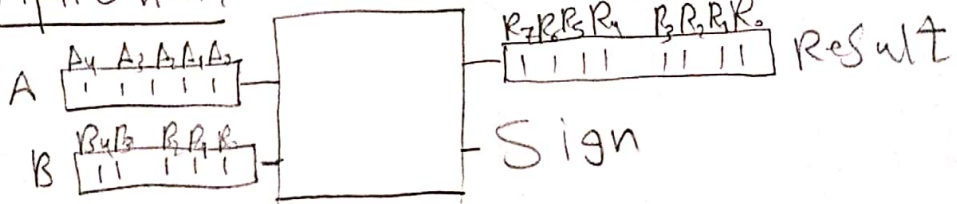


* Final-Subtraction:



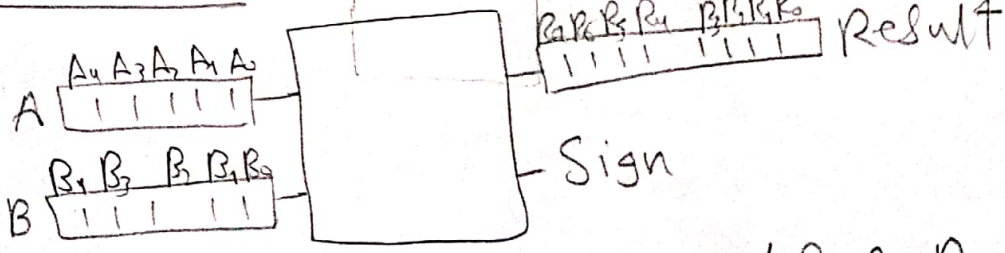
NoTe: A_4 → Sign of A / B_4 → Sign of B / R_4, R_5, R_6, R_7 → always will be Zeros

* Final Multiplication:



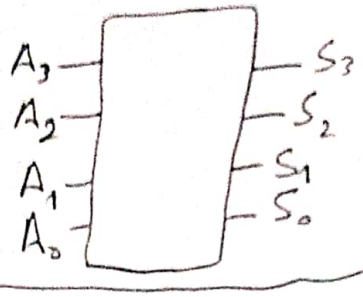
NoTe: A_4 → Sign of A / B_4 → Sign of B /

* Final Division:

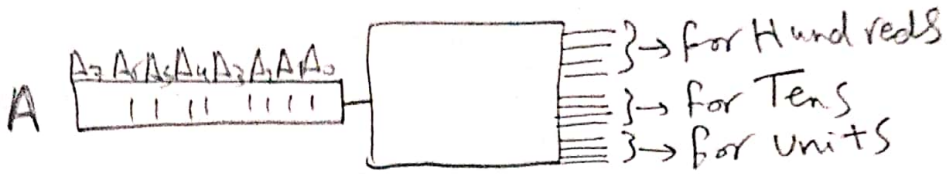


NoTe: A_4 → Sign of A / B_4 → Sign of B / R_4, R_5, R_6, R_7 → will be always Zeros

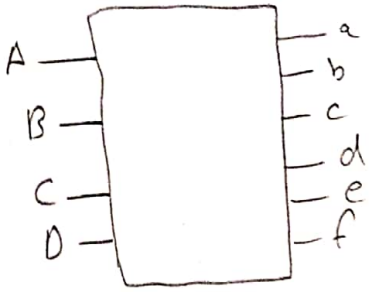
* Binary To BCD (4-Bits):

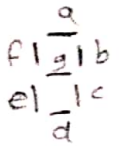


* Binary To BCD (8-Bits):

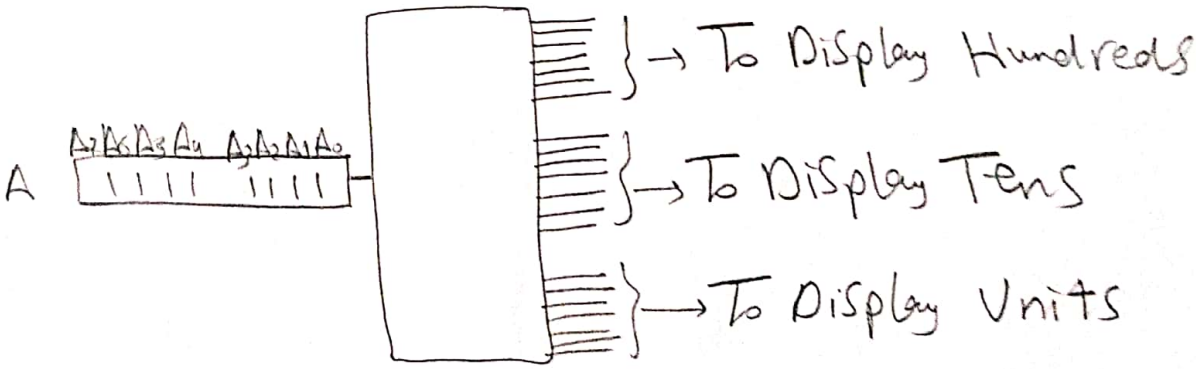


* BCD To 7-Segment:

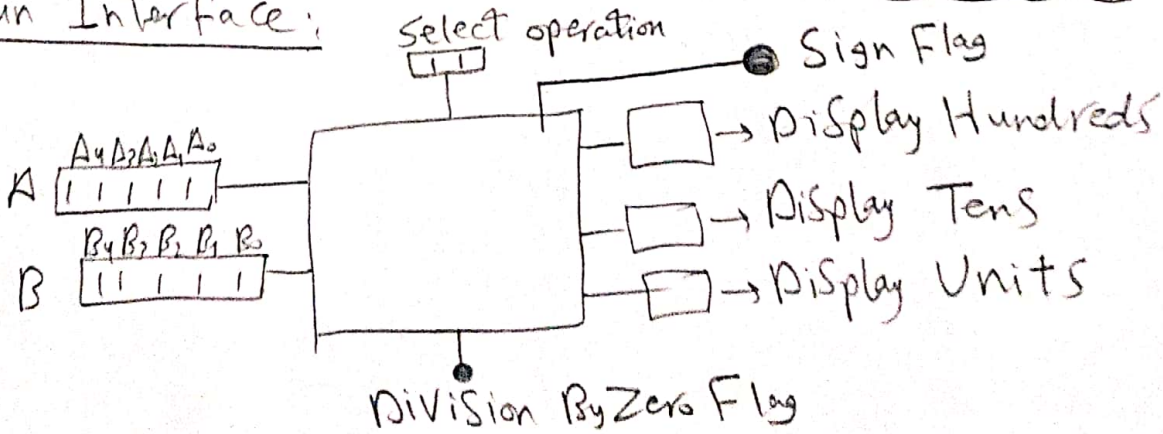




* Full Binary to BCD && 7-Segment:



* Main Interface:

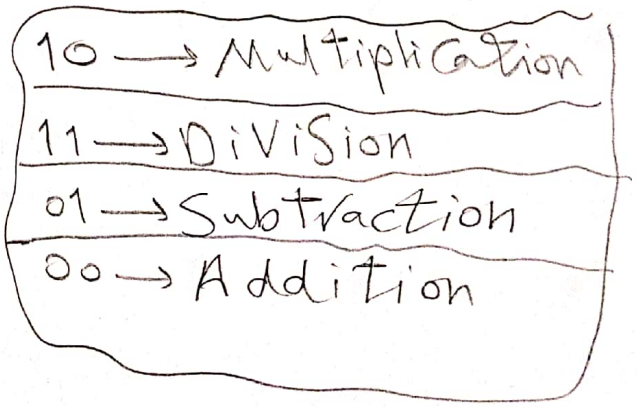


NoTe: No need for zero Flag as the result Zero will be displayed on the 7-Segment Display.

The Coming pages explains every thing in the project

Important

Select operation



Comparator

A_0	B_0	L_0	S_0	E_0
0	0	0	0	1
0	1	0	1	0
1	0	1	0	0
1	1	0	0	1

$L_0 = A_0 B_0'$

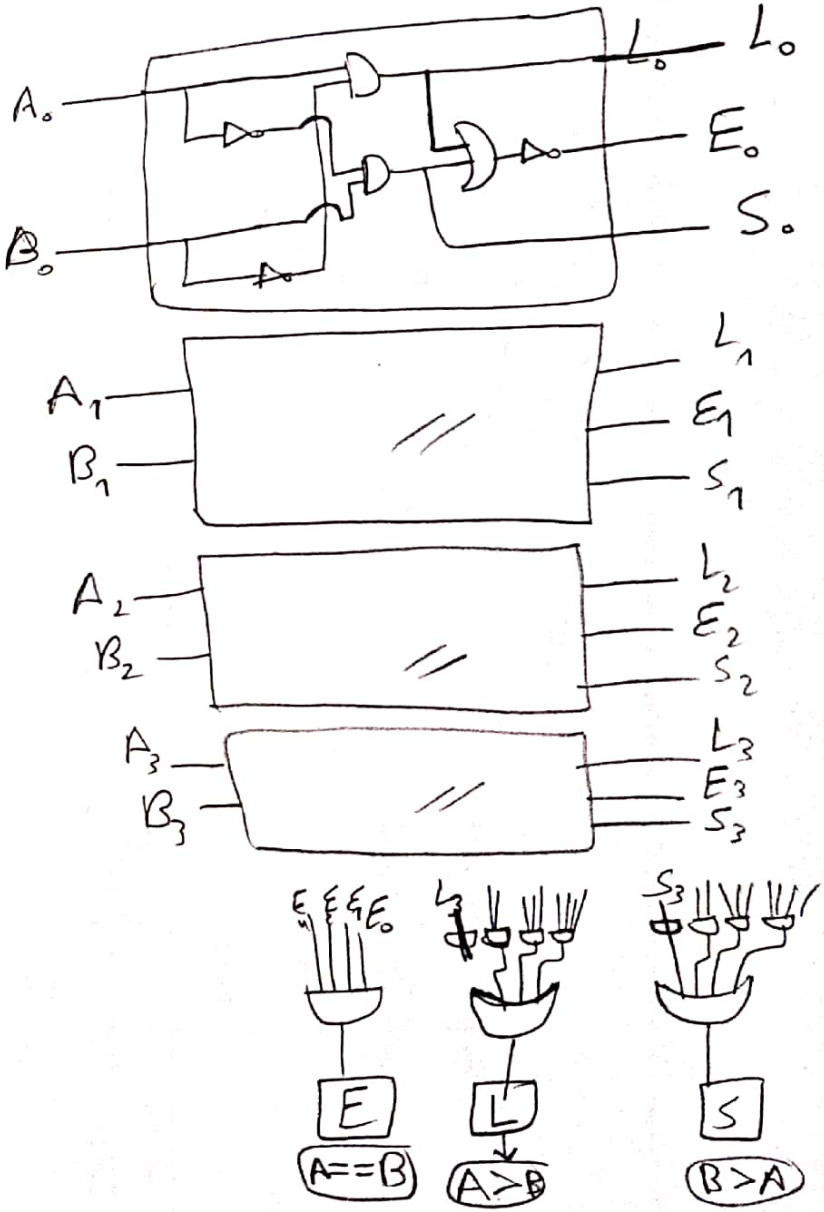
$S_0 = A_0' B_0$

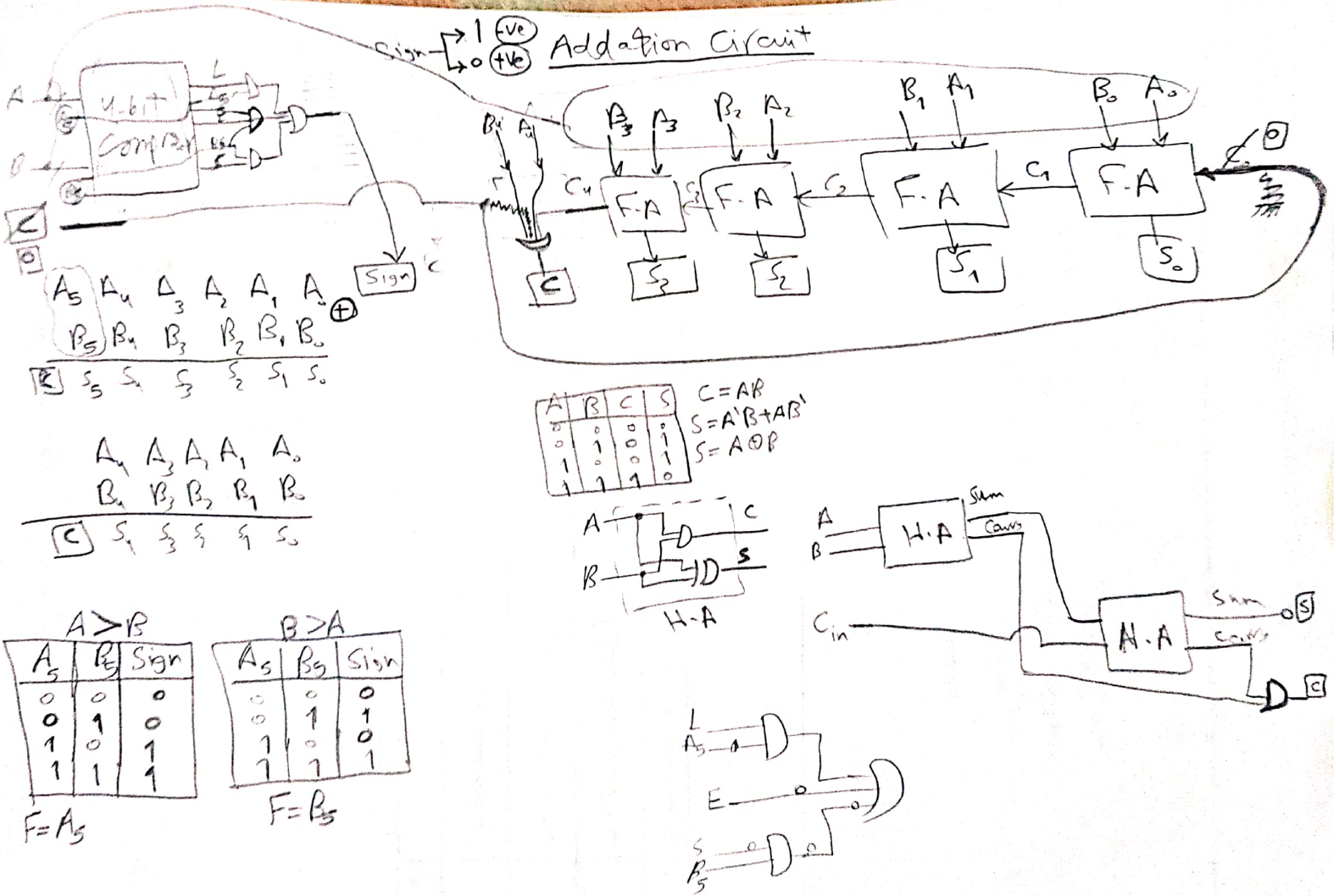
$E_0 = (L_0 + S_0)'$

$L = L_3 + E_3 L_2 + E_3 E_2 L_1 + E_3 E_2 E_1 L_0$

$S = S_3 + E_3 S_2 + E_3 E_2 S_1 + E_3 E_2 E_1 S_0$

$E = E_4 E_2 E_1 E_0$





Multiplication

1111×1111

$B_3\ B_2\ B_1\ B_0$

$A_3\ A_2\ A_1\ A_0$

$A_0B_3\ A_0B_2\ A_0B_1\ A_0B_0$

$A_1B_3\ A_1B_2\ A_1B_1\ A_1B_0$

$A_2B_3\ A_2B_2\ A_2B_1\ A_2B_0$

$A_3B_3\ A_3B_2\ A_3B_1\ A_3B_0$

$C_7\ C_6\ C_5\ C_4\ C_3\ C_2\ C_1\ C_0$

225

2	225	
2	112	1
2	56	0
2	28	0
2	14	0
2	7	0
2	3	1
2	1	1
2	0	1

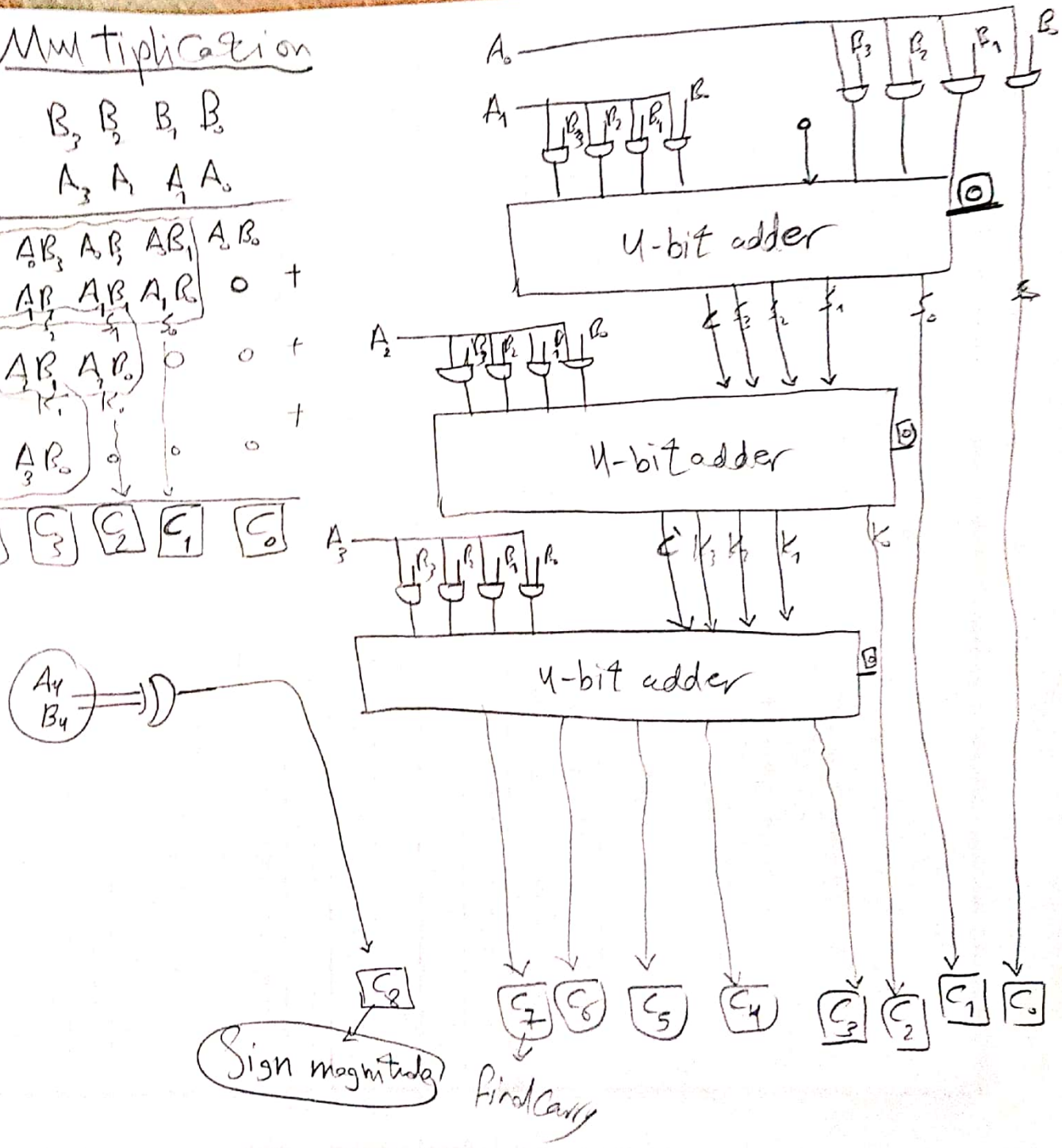
11100001

Sign magnitude

A	B	C_8
0	0	0
0	1	1
1	0	1
1	1	0

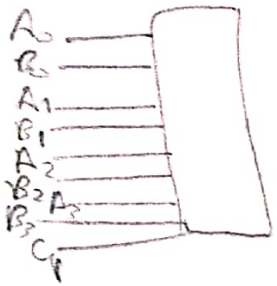
$A \oplus B$

$C_8 = A \oplus B$



4-Bit Sub

$A_3A_2A_1A_0$
$B_3B_2B_1B_0$

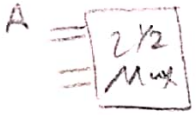


0001 - 0001
0000

$B_3B_2B_1B_0 \ldots A_3$

$B_3B_2B_1B_0 \overline{)A_3A_2A_1A_0}$

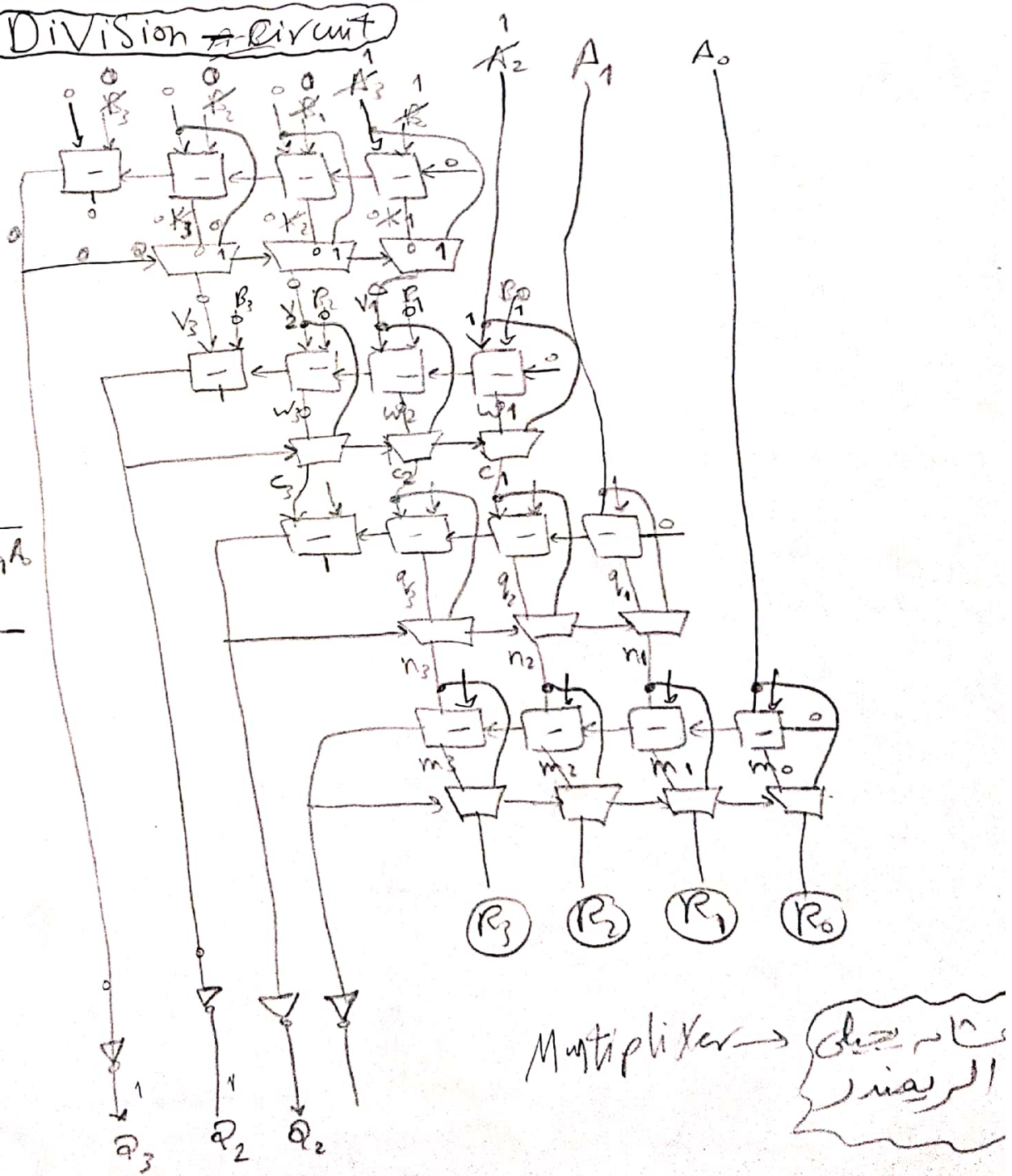
$0001 \overline{)1111}$



$$\begin{array}{r} Q_2 \\ Q_2W_3 \\ V_2 \\ \hline V_2W_3 \\ V_2Q_2 \quad 0 \quad + \\ \hline V_2Q_2 \; V_2W_3 \end{array}$$

$$\begin{array}{r} B_2\;B_1\;B_0 \\ A_3\;A_1\;A_0 \\ \hline A_0B_2 \;\; A_0B_1 \;\; A_0B_0 \\ A_1B_2 \;\; A_1B_1 \;\; A_1B_0 \quad 0 \quad + \\ A_2B_2 \;\; A_2B_1 \;\; A_2B_0 \quad 0 \quad 0 \quad + \\ \hline C \quad C \quad C \quad C \quad C \end{array}$$

Division Circuit



Multiplixer → شامل جميع الريفيدر

1110
0011
10001

225
0111
0011
1010

0100
0011
0111

Page / Date /

11100001

111 0001

1010 0001

1+2+4+8
15

1111

0100 0001

0111 0001

1110 001

0001 001

0010 01

0100 1

0111 1

1111

1010
0011
1101

1010
0011
0111

1010
0011
0101

225

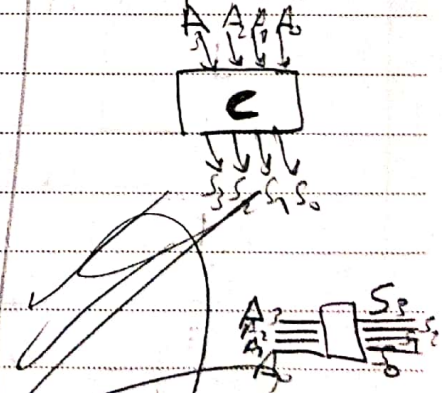
2

5

A_3	A_2	A_1	A_0	S_3	S_2	S_1	S_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	0
0	0	1	1	0	0	1	1
0	1	0	0	0	1	0	0
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	Don't care			
1	0	1	1				
1	1	0	0				
1	1	0	1				
1	1	1	0				
1	1	1	1				

2

0101
0011
1000



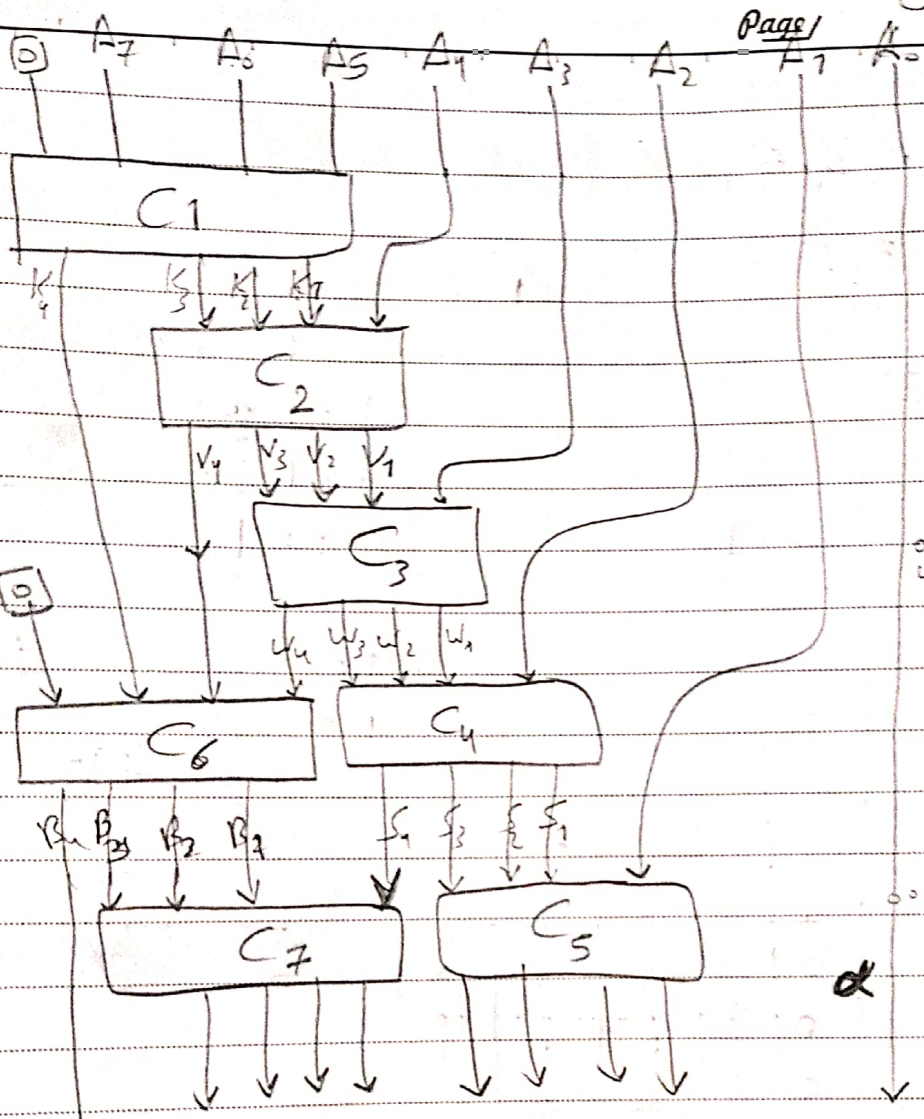
1111 1111

1+2+4 = 7

0111

1010

Page / Date /



255

1100

+2+1

0001 0101 1111

1100

0110 1111

111

0001 0001 0001

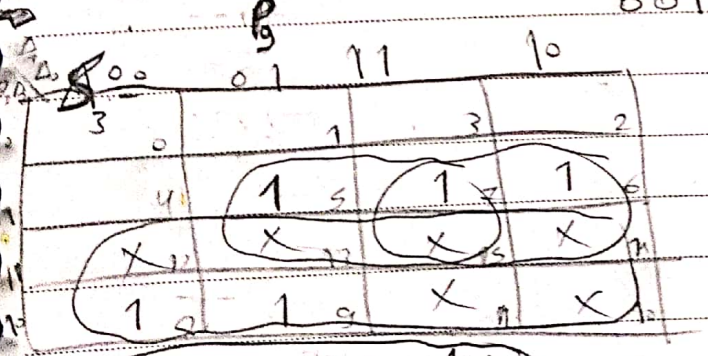
A7

1001 1111

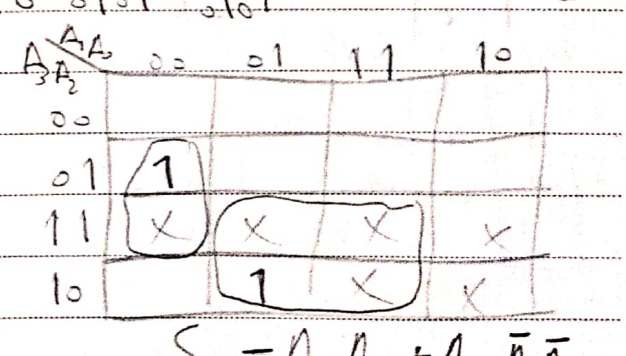
1XXX XXXX

255

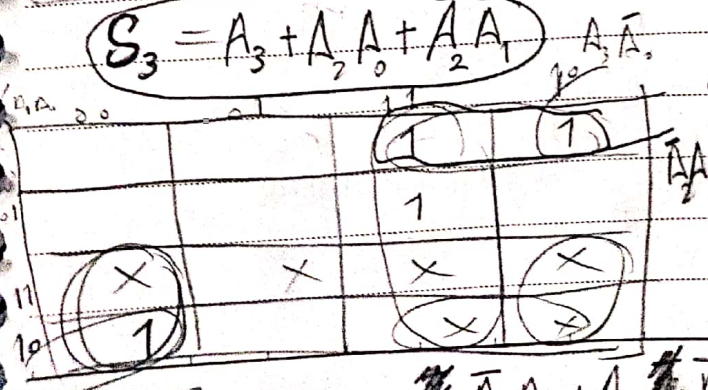
0010 0101 0101



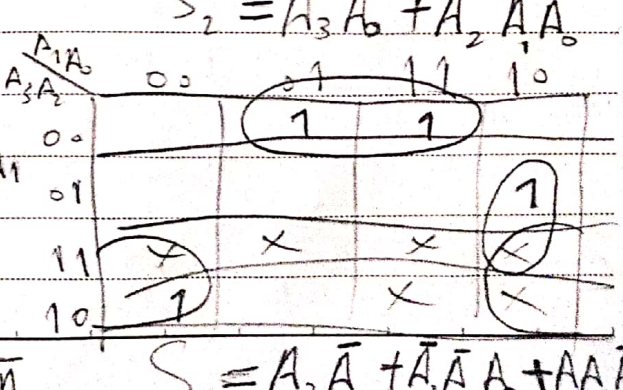
$S_3 = A_3 + A_2A_1 + A_2A_0 + A_3\bar{A}_0$



$S_2 = A_3A_0 + A_2\bar{A}_1\bar{A}_0$

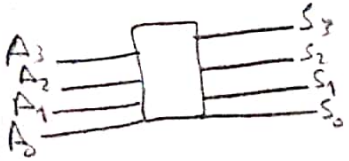


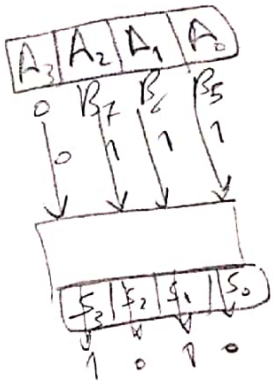
$S_1 = A_1A_0 + \bar{A}_2A_1 + A_3\bar{A}_0$



$S_0 = A_3\bar{A}_0 + \bar{A}_3\bar{A}_2A_0 + A_2A_1\bar{A}_0$

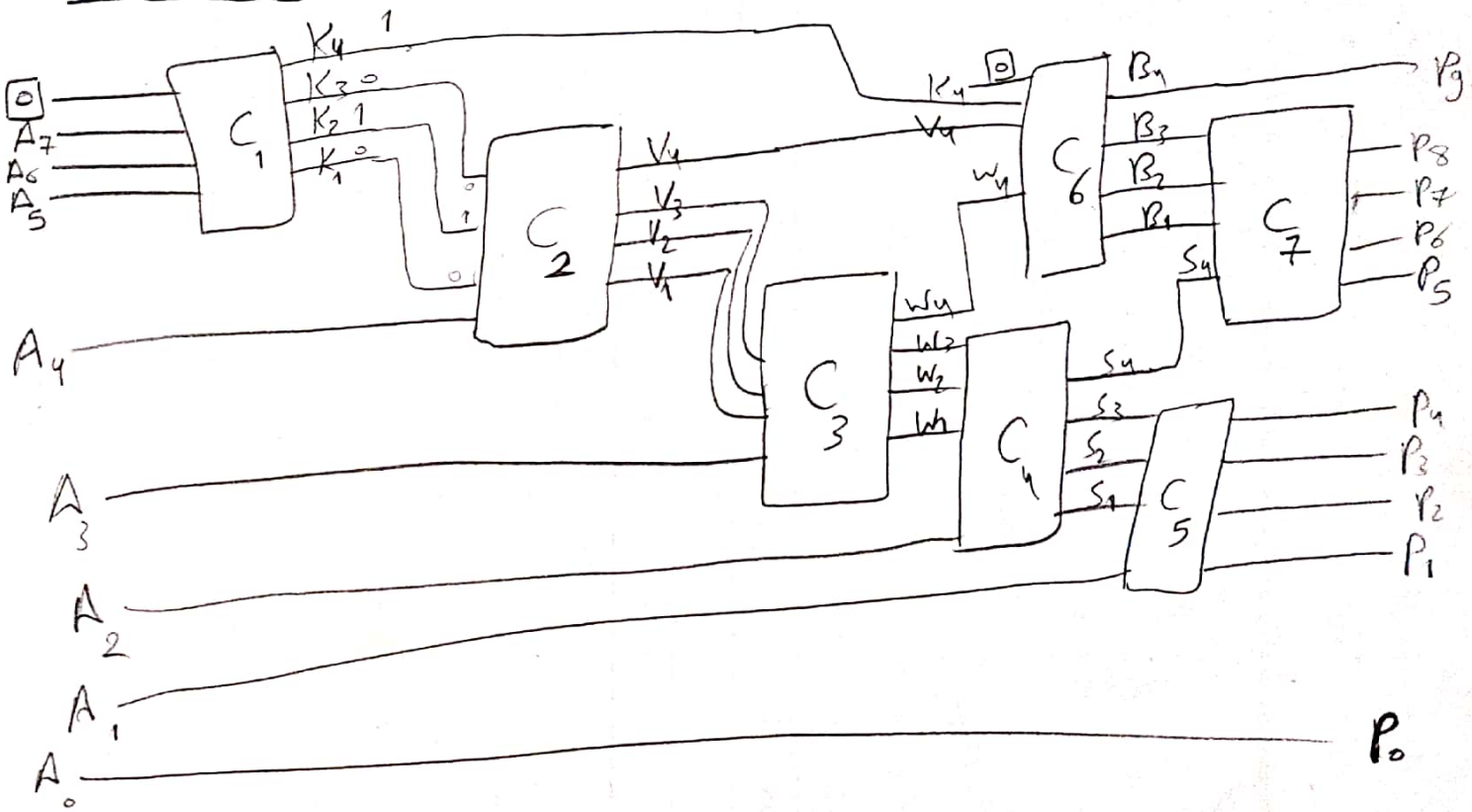
A	B	C	D	E	F	g	h





$$S_3 = A_3 + A_2A_0 + A_2A_1$$
$$S_2 = A_3A_0 + A_2\bar{A}_1\bar{A}_0$$
$$S_1 = A_1A_0 + A_1\bar{A}_2 + A_3\bar{A}_0$$
$$S_0 = A_3\bar{A}_0 + \bar{A}_3\bar{A}_2A_0 + A_2A_1\bar{A}_0$$

Binary To BCD (8-Bits)



always Zeros

P11 P10

1111 1111

225

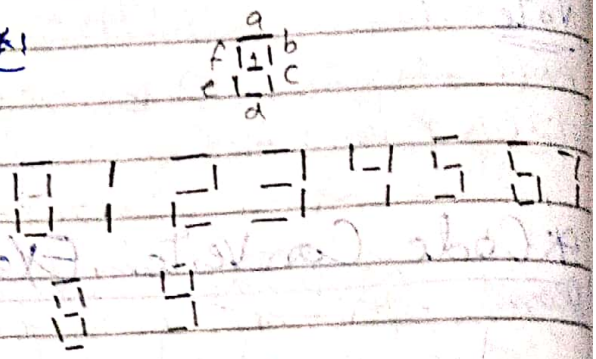
Result

P9	P8	P7	P6	P5	P4	P3	P2	P1	P0
1	0	0	1	0	1	0	1	0	1

Subject موضوع الدرس | Date التاريخ

* BCD to Seven-Segment Decoder *

	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1
10	1	0	1	0	0	0	0	0	0	0	0
11	1	0	1	1	0	0	0	0	0	0	0
12	1	1	0	0	0	0	0	0	0	0	0
13	1	1	0	1	0	0	0	0	0	0	0
14	1	1	1	0	0	0	0	0	0	0	0
15	1	1	1	1	0	0	0	0	0	0	0



* we cannot use the don't care condition here for the six binary combinations 1010-1111, as the design will most likely produce some arbitrary and meaningless display of the unused combinations

$a = \bar{A}C + \bar{A}B\bar{D} + \bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}$

$b = \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD + A\bar{B}\bar{C}$

$c = \bar{A}\bar{B} + \bar{A}D + \bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}$

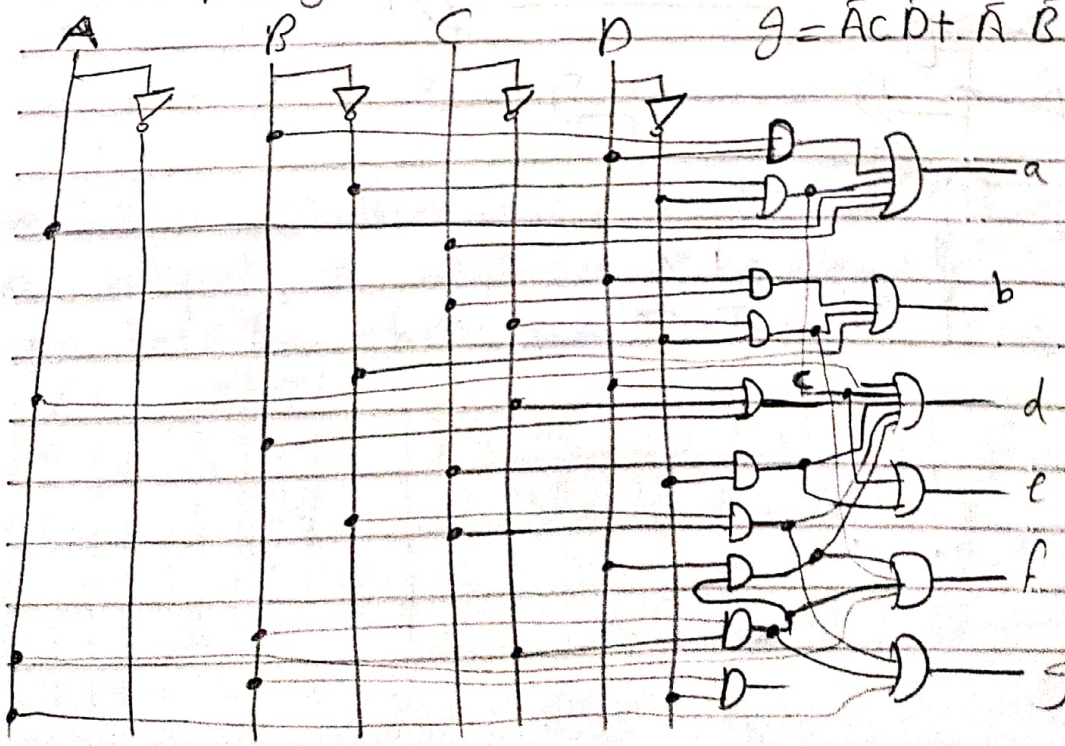
$d = \bar{A}C\bar{D} + \bar{A}\bar{B}C + \bar{B}C\bar{D} + A\bar{B}\bar{C} + A\bar{B}\bar{C}D$

$e = \bar{A}C\bar{D} + \bar{B}\bar{C}\bar{D}$

$f = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{C}\bar{D} + \bar{A}B\bar{D} + A\bar{B}\bar{C}$

$g = \bar{A}C\bar{D} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$

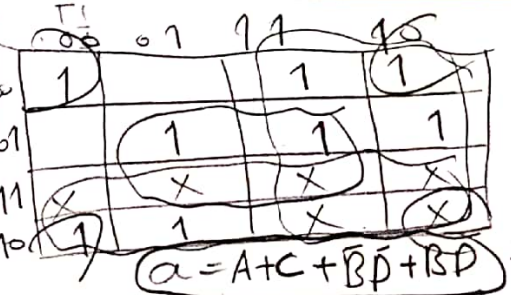
14 AND gate
7 OR gate



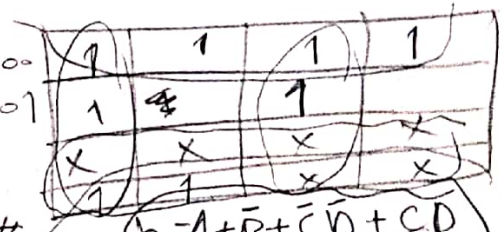
$a = A + C + \bar{B}\bar{D} + BD$

$a = \bar{A}C + AB\bar{D} + \bar{B}\bar{C}D + A\bar{B}\bar{C}$

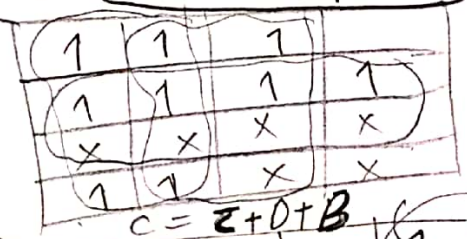
	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1



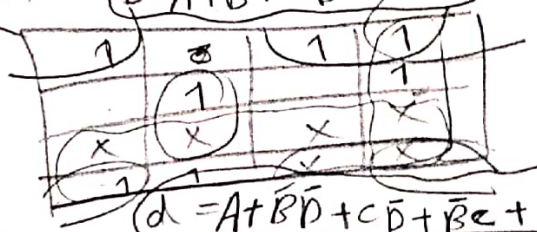
$a = A + C + \bar{B}\bar{D} + BD$



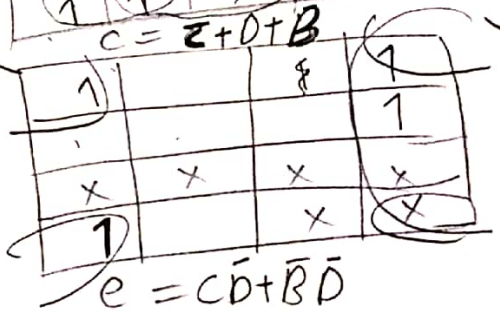
$b = A + \bar{B} + \bar{C}\bar{D} + CD$



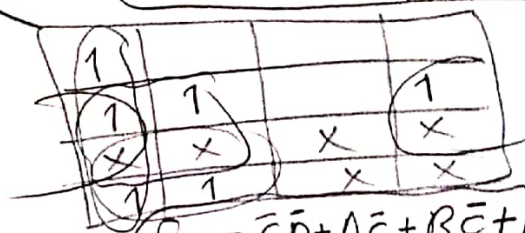
$c = \bar{c} + D + B$



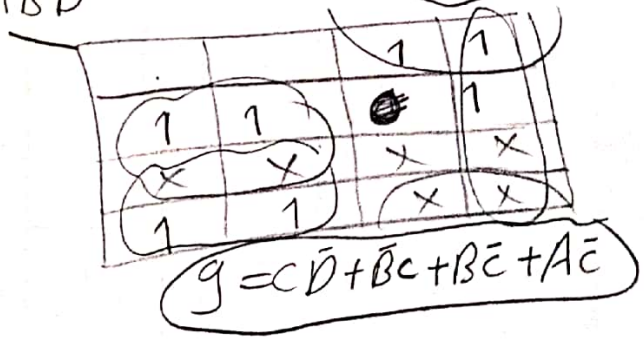
$d = A + \bar{B}\bar{D} + C\bar{D} + \bar{B}\bar{C} + B\bar{C}D$



$e = C\bar{D} + \bar{B}\bar{D}$



$f = \bar{C}\bar{D} + A\bar{C} + B\bar{C} + B\bar{D}$



$g = C\bar{D} + \bar{B}C + B\bar{C} + A\bar{C}$

$a = A + C + \boxed{\bar{B}\bar{D}} + BD$

$b = A + \bar{B} + \boxed{\bar{C}\bar{D}} + CD$

$c = \bar{c} + D + B$

$d = A + \boxed{\bar{B}\bar{D}} + C\bar{D} + \bar{B}C + B\bar{C}D$

$e = C\bar{D} + \boxed{\bar{B}\bar{D}}$

$f = \boxed{\bar{C}\bar{D}} + \boxed{A\bar{C}} + B\bar{C} + B\bar{D}$

$g = C\bar{D} + \bar{B}C + B\bar{C} + \boxed{A\bar{C}}$

7-Segment