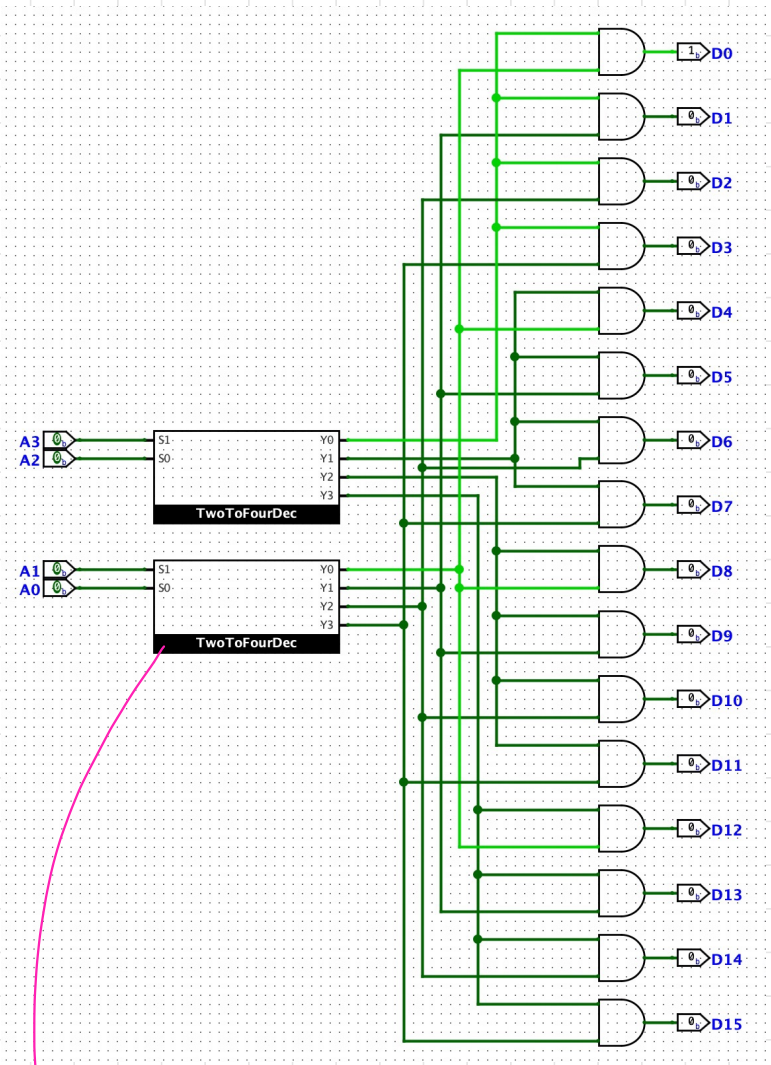
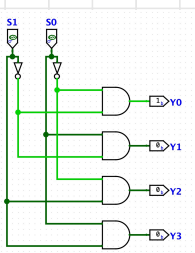
IDS - Homework 4 - Athazahra Nabila Ruby - 2306173113 - KK1

1. a. 4-to-16 line decoder



the 2-to-4 decoder used :



b. 8-to-1 multiplexer

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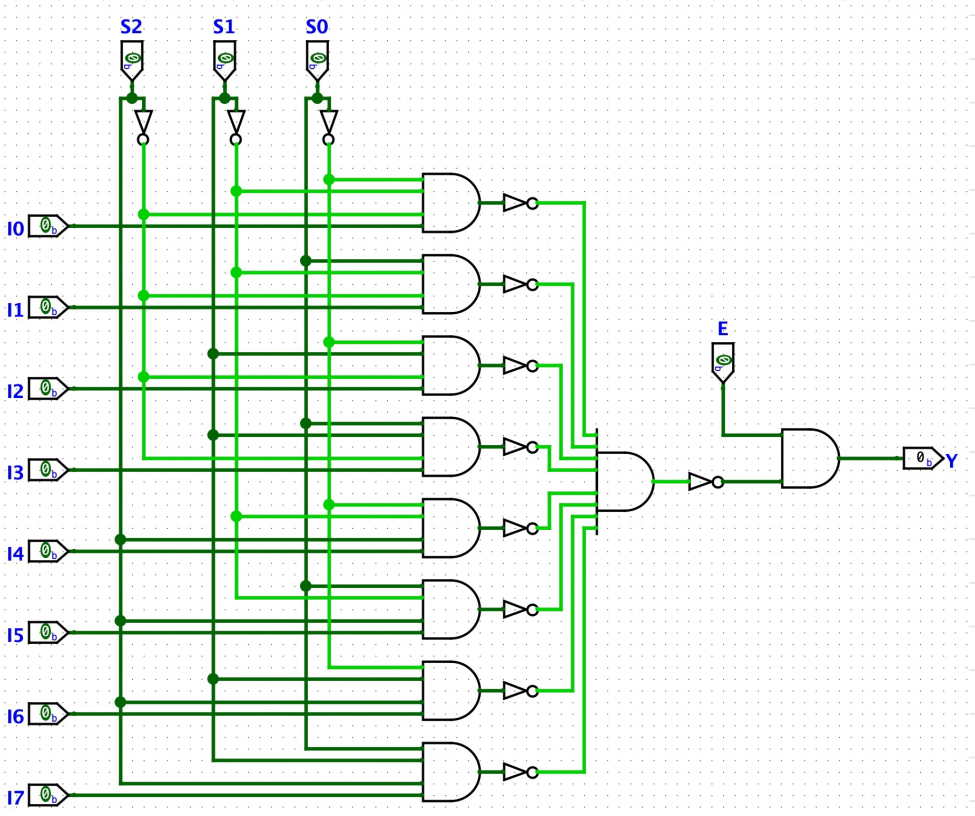

2. a. 1) Specification

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- 4-bit binary code to 4-bit gray code converter
- Implementation : 4-to-1 line multiplexer, AND Gates, OR Gates, NOT gates

3.1

2) Formulation

Variables : - Binary code (input) : A, B, C, D
- Gray code (output) : W, X, Y, Z

Truth Table :

3.2

	INPUT				OUTPUT			
	A	B	C	D	G_3	G_2	G_1	G_0
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	0	0	0	1	1
3	0	0	1	1	0	0	1	0
4	0	1	0	0	0	1	1	0
5	0	1	0	1	0	1	1	1
6	0	1	1	0	0	1	0	1
7	0	1	1	1	0	1	0	0
8	1	0	0	0	1	1	0	0
9	1	0	0	1	1	1	0	1
10	1	0	1	0	1	1	1	1
11	1	0	1	1	1	1	1	0
12	1	1	0	0	1	0	1	0
13	1	1	0	1	1	0	1	1
14	1	1	1	0	1	0	0	1
15	1	1	1	1	1	0	0	0

$G_3 = \sum_m (8, 9, 10, 11, 12, 13, 14, 15)$

$G_2 = \sum_m (4, 5, 6, 7, 8, 9, 10, 11)$

$G_1 = \sum_m (2, 3, 4, 5, 10, 11, 12, 13)$

$G_0 = \sum_m (1, 2, 5, 6, 9, 10, 13, 14)$

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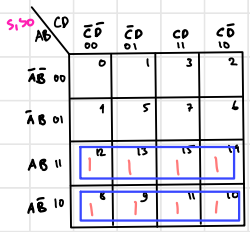
Select inputs = A, B

i) $G_3 = \Sigma m\ (8, 9, 10, 11, 12, 13, 14, 15)$



0 = I_0

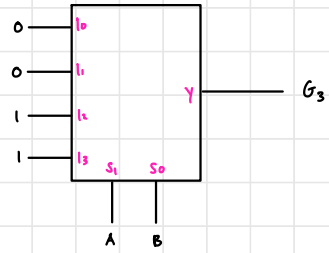
0 = I_1

1 = I_2

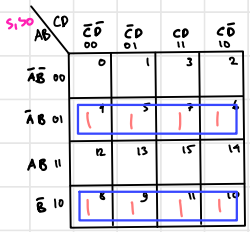
1 = I_3

S_1	S_0	Y
0	0	$I_0 = 0$
0	1	$I_1 = 0$
1	0	$I_2 = 1$
1	1	$I_3 = 1$

4.1



ii) $G_2 = \Sigma m\ (1, 5, 6, 7, 8, 9, 10, 11)$



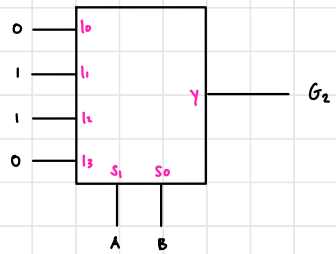
0 = I_0

1 = I_1

0 = I_3

1 = I_2

S_1	S_0	Y
0	0	$I_0 = 0$
0	1	$I_1 = 1$
1	0	$I_2 = 1$
1	1	$I_3 = 0$



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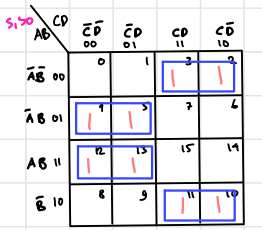
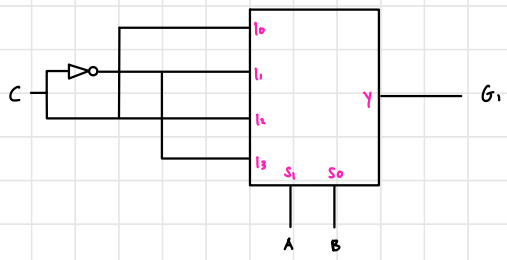
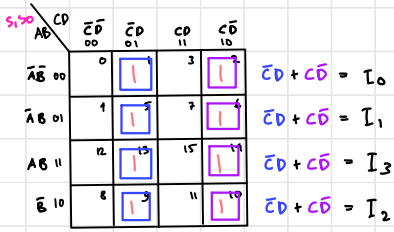
iii) $G_1 = \sum_m (2, 3, 4, 5, 10, 11, 12, 13)$



S_1	S_0	Y
0	0	$I_0 = C$
0	1	$I_1 = \bar{C}$
1	0	$I_2 = C$
1	1	$I_3 = \bar{C}$

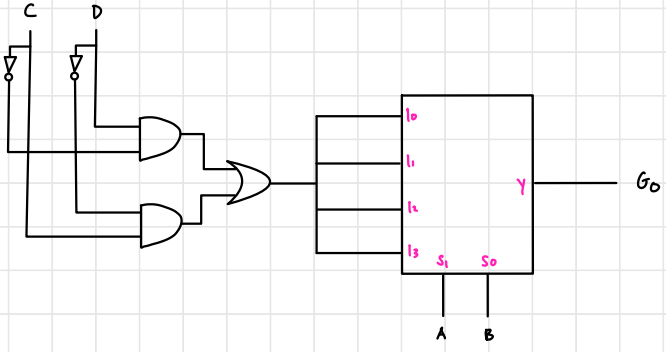


iv) $G_0 = \sum_m (1, 2, 5, 6, 9, 10, 13, 14)$



S_1	S_0	Y
0	0	$I_0 = \bar{C}D + C\bar{D}$
0	1	$I_1 = \bar{C}D + C\bar{D}$
1	0	$I_2 = \bar{C}D + C\bar{D}$
1	1	$I_3 = \bar{C}D + C\bar{D}$

5.1



3) Technology Mapping

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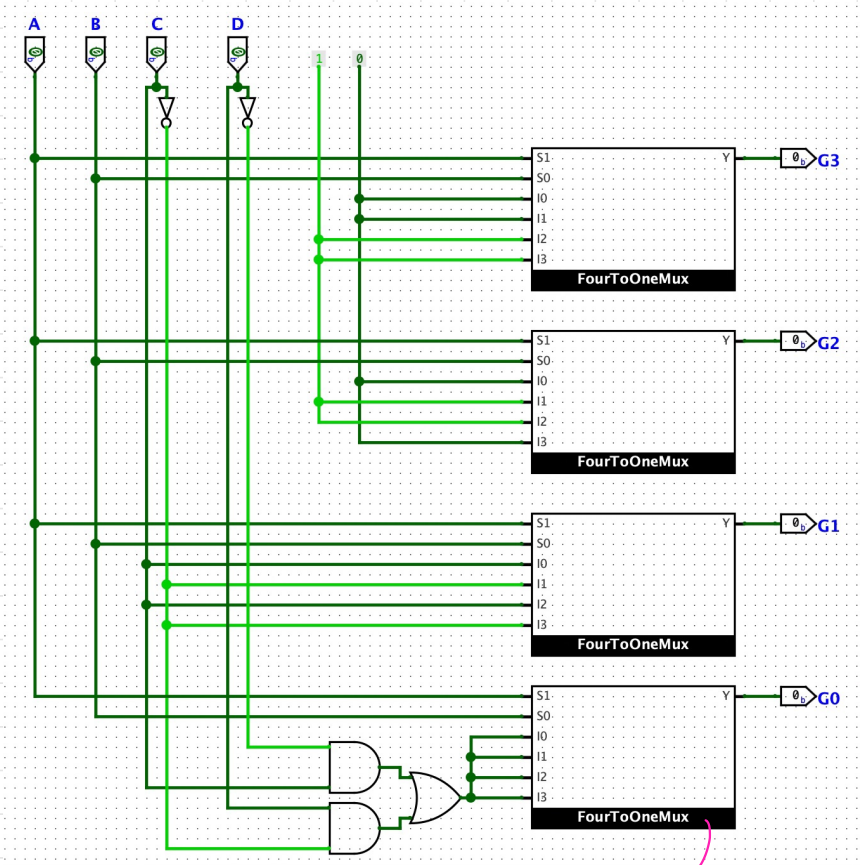
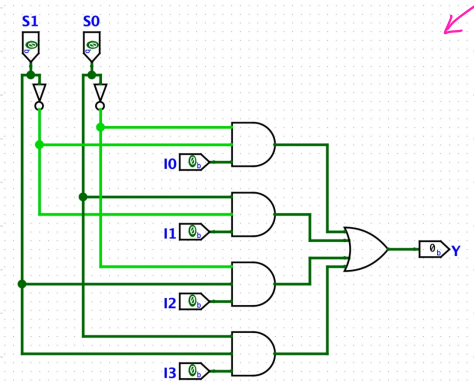


The 4-to-1 Line Multiplexer used :



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b. 1) Specification

- 4-bit binary code to 3-bit output converter
- Implementation : 4-to-1 line multiplexer, NOT Gates

7.1

2) Formulation

Variables :

- Input = A, B, C, D
- Output = X, Y, Z

$X(A,B,C,D) = \sum m\,(0,1,6,7,8,9,14,15)$

$Y(A,B,C,D) = \sum m\,(2,3,10,11)$

$Z(A,B,C,D) = \sum m\,(0,2,5,7,9,11,12,14)$

Truth Table :

	Input				output		
	A	B	C	D	X	Y	Z
0	0	0	0	0	1	0	1
1	0	0	0	1	1	0	0
2	0	0	1	0	0	1	1
3	0	0	1	1	0	1	0
4	0	1	0	0	0	0	0
5	0	1	0	1	0	0	1
6	0	1	1	0	1	0	0
7	0	1	1	1	1	0	1
8	1	0	0	0	1	0	0
9	1	0	0	1	1	0	1
10	1	0	1	0	0	1	0
11	1	0	1	1	0	1	1
12	1	1	0	0	0	0	1
13	1	1	0	1	0	0	0
14	1	1	1	0	1	0	1
15	1	1	1	1	1	0	0

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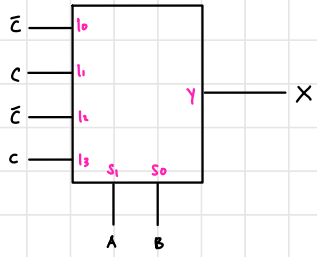
i) $X(A,B,C,D) = \sum m\,(0,1,6,7,8,9,14,15)$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	$C\bar{D}$ 11	CD 10
$\bar{A}\bar{B}$ 00	0 1	1 1	3	2
$\bar{A}B$ 01	4	5	7 1	6 1
AB 11	12	13	15 1	14 1
$A\bar{B}$ 10	8 1	9 1	11	10

$\bar{C} = I_0$
$C = I_1$
$C = I_3$
$\bar{C} = I_2$

S_1	S_0	Y
0	0	$I_0 = \bar{C}$
0	1	$I_1 = C$
1	0	$I_2 = \bar{C}$
1	1	$I_3 = C$

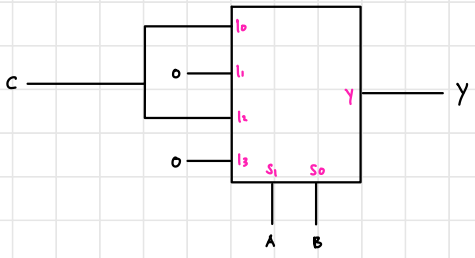


ii) $Y(A,B,C,D) = \sum m\,(2,3,10,11)$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	$C\bar{D}$ 11	CD 10
$\bar{A}\bar{B}$ 00	0	1	3 1	2 1
$\bar{A}B$ 01	4	5	7	6
AB 11	12	13	15	14
$A\bar{B}$ 10	8	9	11 1	10 1

$C = I_0$
$0 = I_1$
$0 = I_3$
$C = I_2$

S_1	S_0	Y
0	0	$I_0 = C$
0	1	$I_1 = 0$
1	0	$I_2 = C$
1	1	$I_3 = 0$



iii) $Z(A,B,C,D) = \sum m\ (0, 2, 5, 7, 9, 11, 12, 14)$

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S1,S0 \ AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	0	1	3	2
$\bar{A}B$ 01	4	5	7	6
AB 11	12	13	15	14
$A\bar{B}$ 10	8	9	11	10

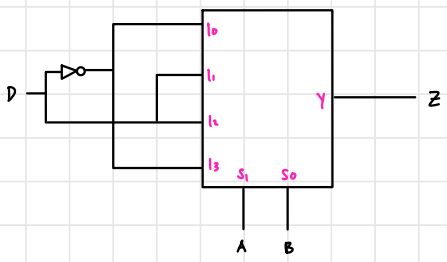
$\bar{D} = I_0$

$D = I_1$

$\bar{D} = I_3$

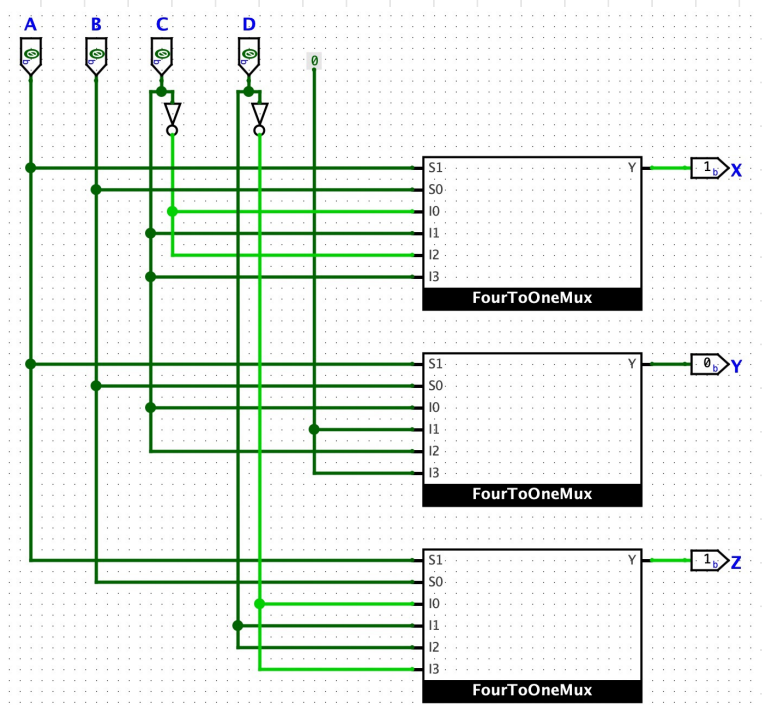
$D = I_2$

S_1	S_0	Y
0	0	$I_0 = \bar{D}$
0	1	$I_1 = D$
1	0	$I_2 = D$
1	1	$I_3 = \bar{D}$



3) Technology Mapping

The 4-to-1 line multiplexer used is the same one used in 2a.



3. a. $F(A,B,C,D) = \sum_m (0,2,8,9,10,14)$

$d(A,B,C,D) = \sum_m (1,4,5,7,15)$

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1) Formulation

Variables : - input = A, B, C, D

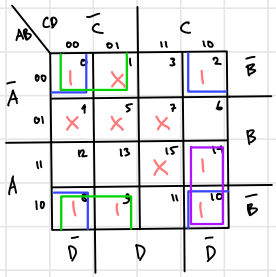
- output = F

Truth Table :

	A	B	C	D	F
0	0	0	0	0	1
1	0	0	0	1	X
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	X
5	0	1	0	1	X
6	0	1	1	0	0
7	0	1	1	1	X
8	1	0	0	0	1
9	1	0	0	1	1
10	1	0	1	0	1
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	1
15	1	1	1	1	X

2) Optimization

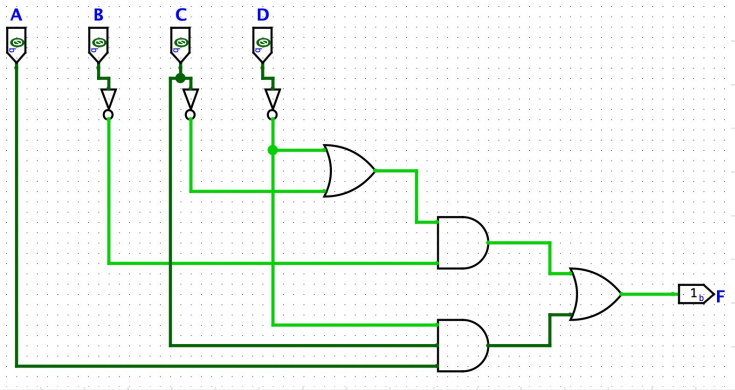
SOP of F



Optimized SOP : $\bar{B}\bar{D} + \bar{B}\bar{C} + AC\bar{D}$

$= \bar{B}(\bar{D} + \bar{C}) + AC\bar{D}$

3) Technology Mapping



b. $F(A,B,C,D) = \Pi_M (3,4,5,7,8,10,11)$

$d(A,B,C,D) = \sum_m (1,2,6,9,15)$

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1) Formulation

Variables: - input = A, B, C, D

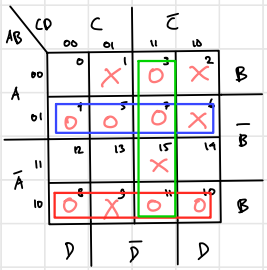
- output = F

Truth Table:

	A	B	C	D	F
0	0	0	0	0	1
1	0	0	0	1	X
2	0	0	1	0	X
3	0	0	1	1	0
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	X
7	0	1	1	1	0
8	1	0	0	0	0
9	1	0	0	1	X
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	1
13	1	1	0	1	1
14	1	1	1	0	1
15	1	1	1	1	X

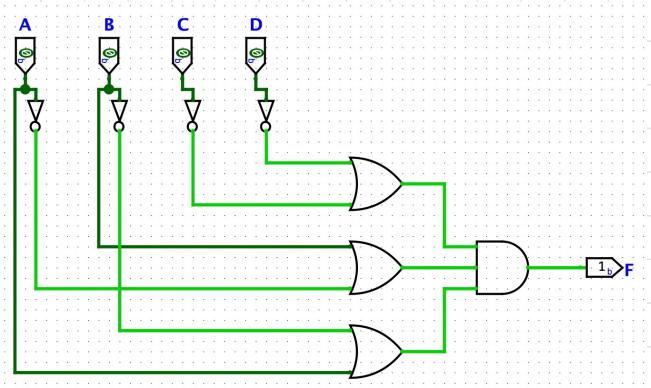
2) Optimization

POS of F



Optimized POS : $(A+\bar{B}) \cdot (\bar{A}+B) \cdot (\bar{C}+\bar{D})$

3) Technology Mapping



Index of comments

3.1 you need to include this in spesification:
Input: binary code for digits 0 through 15: 4-bit
patterns 0000 to 1111
Output: gray code for digits 0 through 15: 4-bit patterns

3.2 you said that the output is W, X, Y, Z but why now the output is G3, G2, G1, G0

4.1 the most optimal function is G3=A

5.1 this is correct but you can simplify the function by writing it like this G0 = C xor D

7.1 you need to include this in spesification:
Input: binary code for digits 0 through 15: 4-bit patterns 0000 to 1111
Output: code from mapping inputs with each function: 3-bit patterns