LOGIC DESIGN

Question Bank

SOLUTION

Note. / /

1- Simplify the following functions:

(a)- $F(A,B,C,D) = BC + A\bar{C} + AB + BCD$

$$= (CB + \bar{C}A + \cancel{BA}) + BCD$$
$$= BC[1+D] + A\bar{C}$$
$$= \boxed{A\bar{C} + BC}$$

(b)- $F(A,B,C,D) = BC + \bar{A} + AB + BCD$

$$= BC[1+D] + (\bar{A}+A).(\bar{A}+B)$$
$$= BC + \bar{A} + B$$
$$= B[1+C] + \bar{A}$$
$$= \boxed{\bar{A} + B}$$

(c)- $F(A,B,C) = ABC + \bar{A}\bar{B}C + \bar{A}BC + AB\bar{C} + \bar{A}\bar{B}\bar{C}$

$$= BC[A+\bar{A}] + \bar{A}\bar{B}[C+\bar{C}] + AB\bar{C}$$
$$= B[C + A\bar{C}] + \bar{A}\bar{B}$$
$$= B[(C+A).(C+\bar{C})] + \bar{A}\bar{B}$$
$$= \boxed{B(C+A) + \bar{A}\bar{B}}$$

(d)- $F(A,B,C,D) = [(CD)' + A]' + A + CD + AB$

$$= [CD.\bar{A}] + A(1+B) + CD$$
$$= CD[1+\bar{A}] + A$$
$$= \boxed{A + CD}$$

(e)- $F(A,B,C,D) = AB + (AB)' + AB\bar{C} + \bar{A}\bar{B}C$

$= AB[\cancel{1} + \bar{C}] + (\bar{A} + \bar{B}) + \bar{A}\bar{B}C$

$= [AB + (\bar{A} + \bar{B})] + \bar{A}\bar{B}C$

$= AB + \bar{B} + \bar{A}(\cancel{1} + \bar{B}C)$

$= AB + \bar{A} + \bar{B}$

$= \boxed{1}$

(f)- $F(A,B,C,D) = (AB + \bar{A}C + \cancel{B}C)(\bar{B}A + \bar{B}\bar{C})$

$= \cancel{A}AB\bar{B} + \cancel{A}B\bar{B}\bar{C} + \cancel{A}\bar{A}\bar{B}C + \cancel{\bar{A}}\bar{B}C\bar{C}$

$= \boxed{0}$

$\boxed{2}$- Complement the Following Functions:

(a)- $F(A,B,C,D) = \bar{B}D + \bar{A}B\bar{C} + ACD + \bar{A}BC$

$= D[\bar{B} + AC] + \bar{A}B[\cancel{C + \bar{C}}]$

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

$\therefore \bar{F} = [D(\bar{B} + AC)]' . [\bar{A}B]'$

$= [\bar{D} + (\bar{B} + AC)'] . [A + \bar{B}]$

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

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

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

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

ⓑ- $F(A,B,C) = A + (ABC)'$

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

$= 1$

$\therefore \bar{F} = \boxed{0}$

ⓒ- $F(A,B,C,D) = (B\bar{C} + \bar{A}D)(A\bar{B} + C\bar{D})$

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

$= 0$

$\therefore \bar{F} = \boxed{1}$

ⓓ- $F(A,B) = (AB)' + \bar{A}$

$= \bar{A} + \bar{B} + \bar{A}$

$= \bar{A} + \bar{B}$

$\therefore \bar{F} = \boxed{AB}$

ⓔ- $F(A,B,C,D) = (\bar{A}BC + \bar{C}D)' + (AC)'$

$\therefore \bar{F} = [(\bar{A}BC + \bar{C}D)' + (AC)']'$

$= (\bar{A}BC + \bar{C}D) \cdot (AC)$

$= A\bar{A}BCC + AC\bar{C}D$

$= \boxed{0}$

Note . / /

3 - Convert the following functions to sum of minterms, then, what are the corresponding maxterms:

ⓐ - $F(x,y,z) = xy + \bar{x}z$

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

$$= \underset{1\,1\,1}{xyz} + \underset{1\,1\,0}{xy\bar{z}} + \underset{0\,1\,1}{\bar{x}yz} + \underset{0\,0\,1}{\bar{x}\bar{y}z}$$

∴ Sum of minterm $= m_1 + m_3 + m_6 + m_7 = \Sigma(1,3,6,7)$

∴ Product of maxterm $= M_0 \cdot M_2 \cdot M_4 \cdot M_5 = \Pi(0,2,4,5)$

ⓑ - $F(A,B,C,D) = AB + \bar{B}\bar{C}D + \bar{A}\bar{B}C$

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

$$= \overset{1}{A}\overset{1}{B}\overset{1}{C}\overset{1}{D} + \overset{1}{A}\overset{1}{B}\overset{1}{C}\overset{0}{\bar{D}} + \overset{1}{A}\overset{1}{B}\overset{0}{\bar{C}}\overset{1}{D} + \overset{1}{A}\overset{1}{B}\overset{0}{\bar{C}}\overset{0}{\bar{D}}$$

$$+ \overset{1}{A}\overset{0}{\bar{B}}\overset{0}{\bar{C}}\overset{1}{D} + \overset{0}{\bar{A}}\overset{0}{\bar{B}}\overset{0}{\bar{C}}\overset{1}{D} + \overset{0}{\bar{A}}\overset{0}{\bar{B}}\overset{1}{C}\overset{1}{D} + \overset{0}{\bar{A}}\overset{0}{\bar{B}}\overset{1}{C}\overset{0}{\bar{D}}$$

∴ Sum of minterm $= m_1 + m_2 + m_3 + m_9 + m_{12} + m_{13} + m_{14} + m_{15}$

$= \Sigma(1,2,3,9,12,13,14,15)$

∴ Product of maxterm $= M_0 \cdot M_4 \cdot M_5 \cdot M_6 \cdot M_7 \cdot M_8 \cdot M_{10} \cdot M_{11}$

$= \Pi(0,4,5,6,7,8,10,11)$.

$\boxed{4}$ - Convert the following functions to Product of Maxterms, then, what are the Corresponding minterms :

ⓐ - $F(X,Y,Z) = (\bar{X}+Y)(\bar{Y}+Z)$

$= [(\bar{X}+Y)+Z\bar{Z}].[(\bar{Y}+Z)+X\bar{X}]$

$= (\underset{1}{\bar{X}}+\underset{0}{Y}+\underset{0}{Z}).(\underset{1}{\bar{X}}+\underset{0}{Y}+\underset{1}{\bar{Z}}).(\underset{0}{X}+\underset{1}{\bar{Y}}+\underset{0}{Z}).(\underset{1}{\bar{X}}+\underset{1}{\bar{Y}}+\underset{0}{Z})$

$\therefore$ Product of Maxterm $= M_2 . M_4 . M_5 . M_6 = \pi(2,4,5,6)$

$\therefore$ Sum of minterm $= m_0 + m_1 + m_3 + m_7 = \Sigma(0,1,3,7)$

ⓑ - $F(A,B,C,D) = \bar{A}B\bar{C} + \bar{B}CD$

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

$= (\bar{A}+\bar{B}).\cancel{(B+\bar{B})}(\bar{B}+\bar{C}).(\bar{A}+C)(B+C).\cancel{(C+\bar{C})}$

$(\bar{A}+D).(B+D).(\bar{C}+D)$

{ عملنا كل قوس لواحده }

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

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

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

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

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

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

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

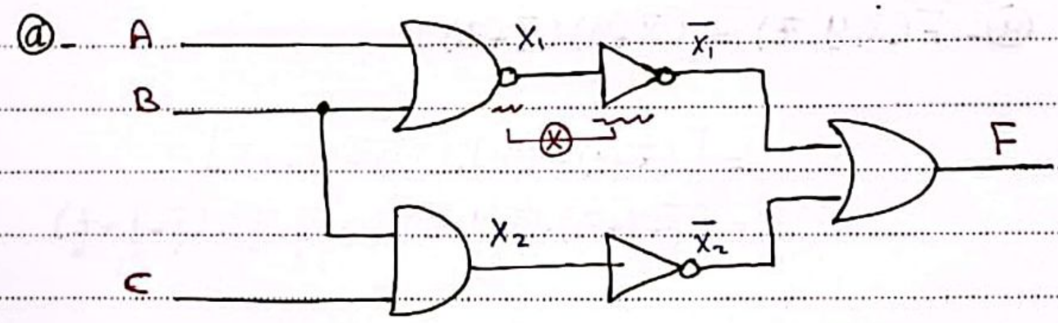
$\therefore F = (\bar{A}+\bar{B}+C+D)(\bar{A}+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+\bar{C}+D)(\bar{A}+\bar{B}+\bar{C}+\bar{D})$
$\bullet(\bar{A}+B+C+D)(A+B+\bar{C}+D)(\bar{A}+B+\bar{C}+D)(A+\bar{B}+\bar{C}+D)$
$\bullet(\bar{A}+B+C+\bar{D})(A+B+C+D)(A+\bar{B}+\bar{C}+\bar{D})(A+B+C+\bar{D})$

$\pi(0,1,2,6,7,8,9,10,12,13,14,15)$.

$\Sigma(3,4,5,11)$.

5 - Find the output of the following Circuits , then find the output In the simplest form, and finally find truth table :

@-



$X_1 = (A+B)'$ $X_2 = B.C$

$\bar{X}_1 = A+B$ $\bar{X}_2 = \bar{B}+\bar{C}$

$\therefore F_1 = \bar{X}_1 + \bar{X}_2 = \boxed{A+B+\bar{B}+\bar{C}}$ ⟶ output

$\therefore F_2 = A + (\overbrace{B+\bar{B}}^{1}) + \bar{C} = \boxed{1}$ ⟶ output (simple form).

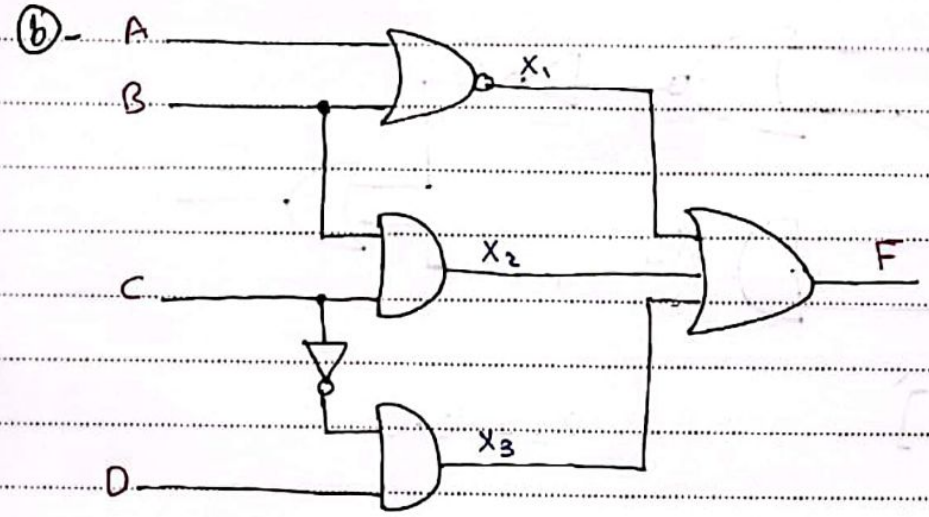
Truth table :

A	B	C	F_1
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$\boxed{F_1 \equiv F_2}$

Note .

(b)-



$X_1 = (A+B)'$ $\quad X_2 = B.C$ $\quad X_3 = \bar{C}.D$

$\therefore F_1 = \boxed{(A+B)' + B.C + \bar{C}.D} \rightarrow$ output

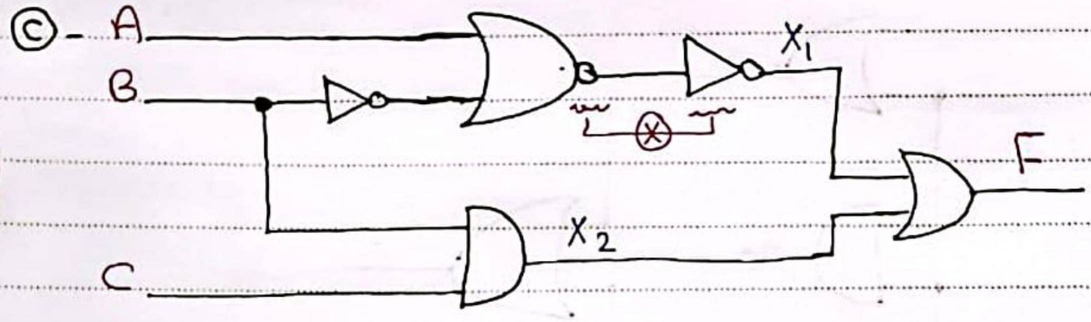
$\therefore F_2 = \boxed{\bar{A}.\bar{B} + B.C + \bar{C}.D} \rightarrow$ output (simple form).

Truth table:

A	B	C	D	X_1	X_2	X_3	F_1
0	0	0	0	1	0	0	1
0	0	0	1	1	0	1	1
0	0	1	0	1	0	0	1
0	0	1	1	1	0	0	1
0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	1
1	0	0	0	0	0	0	0
1	0	0	1	0	0	1	1
1	0	1	0	0	0	0	0
1	0	1	1	0	0	0	0
1	1	0	0	0	0	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	1	0	1
1	1	1	1	0	1	0	1

Note.

(c)



$X_1 = [(A+\bar{B})']'$

$X_1 = A+\bar{B}$

$X_2 = B \cdot C$

$\therefore F_1 = X_1 + X_2 = \boxed{(A+\bar{B}) + B \cdot C} \rightarrow$ output

$\therefore F_2 = \boxed{A+\bar{B}+C} \rightarrow$ output (Simple form).

Truth table:

A	B	C	X_1	X_2	F_1	F_2
0	0	0	1	0	1	1
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	1	0	1	1	1
1	0	0	1	0	1	1
1	0	1	1	0	1	1
1	1	0	1	0	1	1
1	1	1	1	1	1	1

$\boxed{F_1 \equiv F_2}$

$\boxed{6}$ - Explain why? OTP cipher uses XOR for encryption and decryption, then, use OTP to encrypt and decrypt the letter "A" with ASCII $= (65)_{10}$ using the key $(109)_{10}$:

→ OTP Cipher uses XOR, Because, "XOR" operation is reversible for example:

$$CT = P \oplus K \rightarrow P = CT \oplus K$$

→ **At Transmitter**

Plain text 'A'	0 1 0 0 0 0 0 1
key	0 1 1 0 1 1 0 1 ⊕
C.T	0 0 1 0 1 1 0 0

At Reciever

CT	0 0 1 0 1 1 0 0
key	0 1 1 0 1 1 0 1 ⊕
	0 1 0 0 0 0 0 1

Plain text "A" ✓

$\boxed{7}$ - Repeat the Previous quesion ~~with~~ using the following keys:

ⓐ - $key_1 = (143)_{10}$

At Transmitter

Plain text 'A'	0 1 0 0 0 0 0 1
key	1 0 0 0 1 1 1 1 ⊕
C.T	1 1 0 0 1 1 1 0

At Reciever

C.T	1 1 0 0 1 1 1 0
key	1 0 0 0 1 1 1 1 ⊕
	0 1 0 0 0 0 0 1

Plain text "A" ✓

Note .   / /

ⓑ- $key_2 = (213)_{10}$

At Transmitter			At Reciever	
Plaintext 'A'	0100 0001		C.T	1001 0100
key	1101 0101 ⊕		key	1101 0101 ⊕
C.T	1001 0100			0100 0001

Plain text 'A' ✓

ⓒ- $key_3 = (102)_{10}$

At Transmitter			At Reciever	
Plain text 'A'	0100 0001		C.T	0010 0111
key	0110 0110 ⊕		key	0110 0110 ⊕
C.T	0010 0111			0100 0001

Plain text 'A' ✓

ⓓ- $key_4 = (78)_{10}$

At Transmitter			At Reciever	
Plain text 'A'	0100 0001		C.T	0000 1111
Key	0100 1110 ⊕		Key	0100 1110 ⊕
	0000 1111			0100 0001

Plain text 'A' ✓

Note .   /   /

[8]_ Simplify using Maps :

ⓐ_ $F(A,B,C) = A\bar{B} + BC + A\bar{B}C$

A \ BC	00	01	11	10
0			1	
1	1	1	1	

$\therefore F = BC + A\bar{B}$

ⓑ_ $F(A,B,C,D) = \bar{A}C\bar{B} + \bar{A}\bar{D} + C\bar{D}B + \bar{A}B\bar{C}$

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

$\therefore F = \bar{A}\bar{D} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + BC\bar{D}$

ⓒ_ $F(x,y,z) = \Pi(0,1,3,4,5)$

x \ yz	00	01	11	10
0	m_0 0	m_1 0	m_3 0	m_2 1
1	m_4 0	m_5 0	m_7 1	m_6 1

$\therefore F = xy + y\bar{z}$

ⓓ_ $F(A,B,C,D) = \Pi(0,3,4,6,7,9,11,12,13)$

AB \ CD	00	01	11	10
00	m_0 0	m_1 1	m_3 0	m_2 1
01	m_4 0	m_5 1	m_7 0	m_6 0
11	m_{12} 0	m_{13} 0	m_{15} 1	m_{14} 1
10	m_8 1	m_9 0	m_{11} 0	m_{10} 1

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

Note . / /

ⓔ- $F(A,B,C) = \Sigma(0,1,2,4,6)$

A \ BC	00	01	11	10
0	m_0 1	m_1 1	m_3	m_2 1
1	m_4 1	m_5	m_7	m_6 1

$\therefore F = \bar{C} + \bar{A}\bar{B}$

ⓕ- $F(A,B,C,D) = \Sigma(1,2,4,5,6,7,8,12,13,15)$

AB \ CD	00	01	11	10
00	m_0	m_1 1	m_3	m_2 1
01	m_4 1	m_5 1	m_7 1	m_6 1
11	m_{12} 1	m_{13} 1	m_{15} 1	m_{14}
10	m_8 1	m_9	m_{11}	m_{10}

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

ⓖ-

AB \ CD	00	01	11	10
00	0	0	0	1
01	1	0	0	1
11	1	0	1	1
10	1	0	1	1

$\therefore F = C\bar{D} + AC + A\bar{D} + B\bar{C}\bar{D}$

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	1	1
11	0	1	1	0
10	1	0	0	1

$\therefore F = \bar{A}B + BD + \bar{B}\bar{D}$

AB \ CD	00	01	11	10
00	1	X	0	1
01	1	1	0	1
11	1	X	1	1
10	1	0	0	1

$\therefore F = \bar{D} + AB + B\bar{C}$

AB \ CD	00	01	11	10
00	1	0	X	1
01	0	0	1	0
11	X	X	1	1
10	X	0	1	X

$\therefore F = AB + CD + \bar{B}\bar{D}$

AB \ CD	00	01	11	10
00	0	1	1	1
01	0	X	1	1
11	1	0	1	X
10	0	0	1	0

$\therefore F = CD + \bar{A}C + \bar{A}D + AB\bar{D}$

AB \ CD	00	01	11	10
00	1	0	1	0
01	0	1	0	1
11	X	0	1	0
10	0	X	0	1

$\therefore F = A \odot B \odot C \odot D$

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	0	0	X
11	1	1	1	1
10	1	X	1	1

$\therefore F = A + \bar{D}$

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	1	X	0	0
10	X	X	0	0

$\therefore F = \bar{C}\bar{D} + \bar{A}\bar{D}$

AB \ CD	00	01	11	10
00	1	1	0	1
01	0	1	1	1
11	0	0	X	X
10	1	1	1	1

$\therefore F = A\bar{B} + \bar{B}\bar{D} + BC + \bar{A}\bar{C}D$

AB \ CD	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	0	1	X	1
10	1	0	1	0

$\therefore F = A \oplus B \oplus C \oplus D$

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	X	0	0
11	1	X	0	0
10	1	0	0	1

$\therefore F = \bar{C}\bar{D} + \bar{B}\bar{D}$

AB \ CD	00	01	11	10
00	0	1	1	X
01	0	0	1	0
11	1	X	0	0
10	1	1	1	1

$\therefore F = A\bar{B} + A\bar{C} + \bar{A}CD +$ [illegible]$\bar{B}D$

AB \ CD	00	01	11	10
00	1	X	0	0
01	0	1	X	0
11	0	0	1	X
10	0	0	0	1

$\therefore F = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{C}D + AC\bar{D}$

AB \ CD	00	01	10	11
00	0	0	X	0
01	0	X	1	0
11	X	1	0	X
10	0	0	1	1

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

AB \ CD	00	01	11	10
00	1	1	1	1
01	X	X	0	0
11	X	X	0	0
10	1	0	1	1

$\therefore F = \bar{A}\bar{B} + \bar{B}\bar{D} + \bar{B}C$

AB \ CD	00	01	11	10
00	1	1	X	1
01	1	0	0	1
11	1	1	X	1
10	1	1	1	1

$\therefore F = A + \bar{D} + \bar{B}$

AB \ CD	00	01	11	10
00	0	1	1	0
01	0	1	1	1
11	0	X	1	0
10	0	1	1	1

$\therefore F = D + A\bar{B}C + \bar{A}BC$

AB \ CD	00	01	11	10
00	0	X	1	0
01	X	0	0	1
11	1	0	1	1
10	0	X	1	0

$\therefore F = B\bar{D} + ABC + \bar{B}D$

AB \ CD	00	01	11	10
00	1	X	0	0
01	0	1	X	0
11	0	0	1	X
10	0	0	0	1

$\therefore F = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{C}D + AC\bar{D}$

AB \ CD	00	01	10	11
00	0	0	X	0
01	0	X	1	0
11	X	1	0	X
10	0	0	1	1

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

AB \ CD	00	01	11	10
00	1	1	1	1
01	X	X	0	0
11	X	X	0	0
10	1	0	1	1

$\therefore F = \bar{A}\bar{B} + \bar{B}\bar{D} + \bar{B}C$

AB \ CD	00	01	11	10
00	1	1	X	1
01	1	0	0	1
11	1	1	X	1
10	1	1	1	1

$\therefore F = A + \bar{D} + \bar{B}$

AB \ CD	00	01	11	10
00	0	1	1	0
01	0	1	1	1
11	0	X	1	0
10	0	1	1	1

$\therefore F = D + A\bar{B}C + \bar{A}BC$

AB \ CD	00	01	11	10
00	0	X	1	0
01	X	0	0	1
11	1	0	1	1
10	0	X	1	0

$\therefore F = B\bar{D} + ABC + \bar{B}D$

9 - Simplify the following using Maps twice : In Sum of Product form, Then In Product of sums form :

ⓐ- $F(A,B,C,D) = \sum(3,4,6,7,9,10,13,15)$

AB \ CD	00	01	11	10
00	0	0	1	0
01	1	0	1	1
11	0	1	1	0
10	0	1	0	1

$\therefore F_1 = \bar{A}CD + \bar{A}B\bar{D} + ABD + A\bar{C}D + A\bar{B}C\bar{D}$

$\therefore F_2 = (A+C+\bar{D}).(A+B+D).(\bar{A}+\bar{B}+D).$
$(\bar{A}+C+D).(\bar{A}+B+\bar{C}+\bar{D})$

ⓑ- $F(A,B,C,D) = \bar{A}B\bar{C} + A\bar{C} + BD + \bar{A}$

AB \ CD	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	0
10	1	1	0	0

$\therefore F_1 = \bar{A} + \bar{C} + BD$

$\therefore F_2 = (\bar{A}+B+\bar{C}).(\bar{A}+\bar{C}+D)$

ⓒ- $F(A,B,C,D) = \prod(1,3,7,9,11,13,14)$

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	1
11	1	0	1	0
10	1	0	0	1

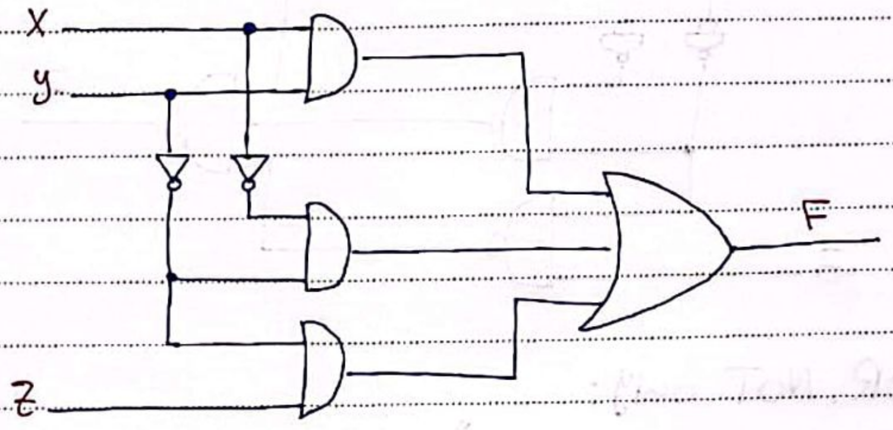
$\therefore F_1 = \bar{C}\bar{D} + \bar{A}\bar{D} + \bar{B}\bar{D} + \bar{A}B\bar{C} + ABCD$

$\therefore F_2 = (B+\bar{D}).(\bar{A}+C+\bar{D}).(A+\bar{C}+\bar{D})$
$(\bar{A}+\bar{B}+\bar{C}+D)$

Note. / /

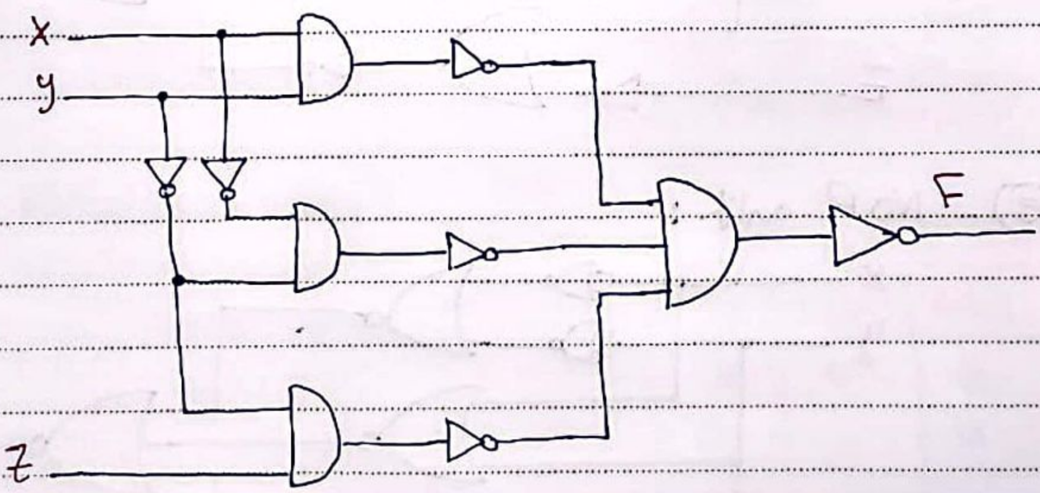
10 - Draw the following function $F(x,y,z) = xy + \bar{x}\bar{y} + \bar{y}z$ using:

ⓐ - AND, OR, and NOT gates:

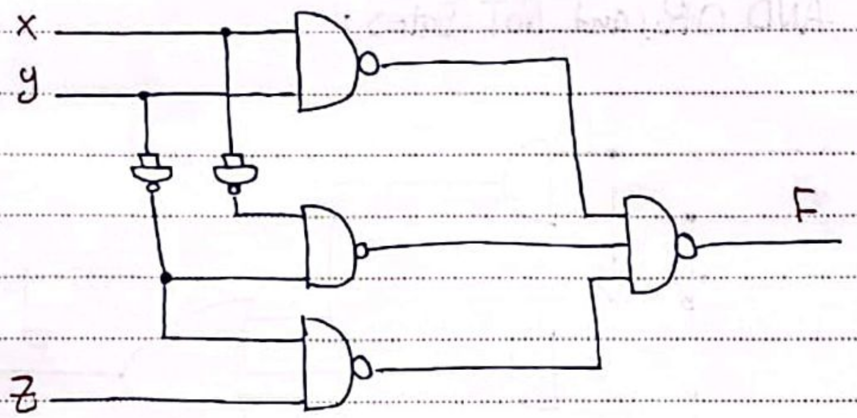


ⓑ - AND, NOT only:

$$\therefore F = [xy + \bar{x}\bar{y} + \bar{y}z]''$$
$$= [(xy)' \cdot (\bar{x}\bar{y})' \cdot (\bar{y}z)']'$$

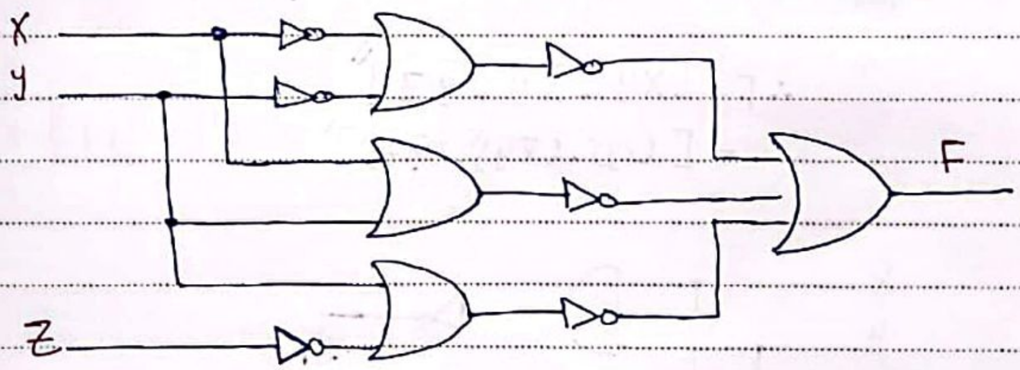


ⓒ- NAND only :

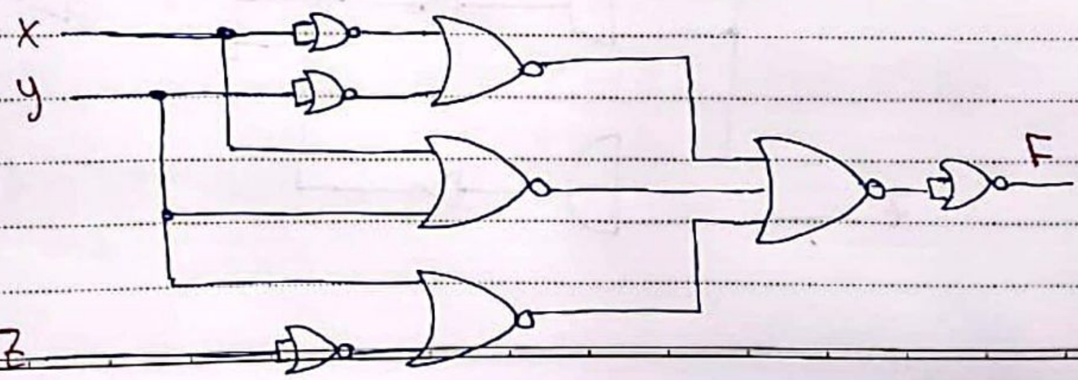


ⓓ- OR, NOT only :

$$\therefore F = (xy)'' + (\bar{x}\bar{y})'' + (\bar{y}z)''$$
$$= (\bar{x}+\bar{y})' + (x+y)' + (y+\bar{z})'$$



ⓔ- NOR only :



[11]- State, then Prove :

@ - De-Morgan laws :

→ $(x+y)' = \bar{x} \cdot \bar{y}$

x	y	L.H.S	R.H.S
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

≡

→ $(x \cdot y)' = \bar{x} + \bar{y}$

x	y	L.H.S	R.H.S
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

≡

ⓑ- Distribution laws :

→ $x \cdot (y+z) = x \cdot y + x \cdot z$

x	y	z	L.H.S	R.H.S
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

≡

ⓒ- Absorption laws :

→ $X + XY = X(\overset{1}{\overline{1+y}}) = X$

X	y	L.H.S	R.H.S
0	0	0	0
0	1	0	0
1	0	1	1
1	1	1	1

≡

Question 9 simplfiy using maps

a. F(A,B,C,D)=∑(3,4,6,7,9,10,13,15).

AB \ CD	00	01	11	10
00	0	0	1	0
01	1	0	1	1
11	0	1	1	0
10	0	1	0	1

$F(A,B,C,D) = A\bar{B}C\bar{D} + A\bar{C}D + ABD + \bar{A}B\bar{D} + \bar{A}CD$

$F(A,B,C,D) = (A+B+D).(A+C+\bar{D}).(\bar{A}+\bar{B}+D).(\bar{A}+C+D).(\bar{A}+B+\bar{C}+\bar{D})$

b. F(A,B,C,D)=A'BC'+AC'+BD+A'

AB \ CD	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	0
10	1	1	0	0

$F(A,B,C,D) = \bar{A} + \bar{C} + BD$ ← sum of product

$F(A,B,C,D) = (\bar{A}+B+\bar{C}).(\bar{A}+\bar{C}+D)$ ← product of sums

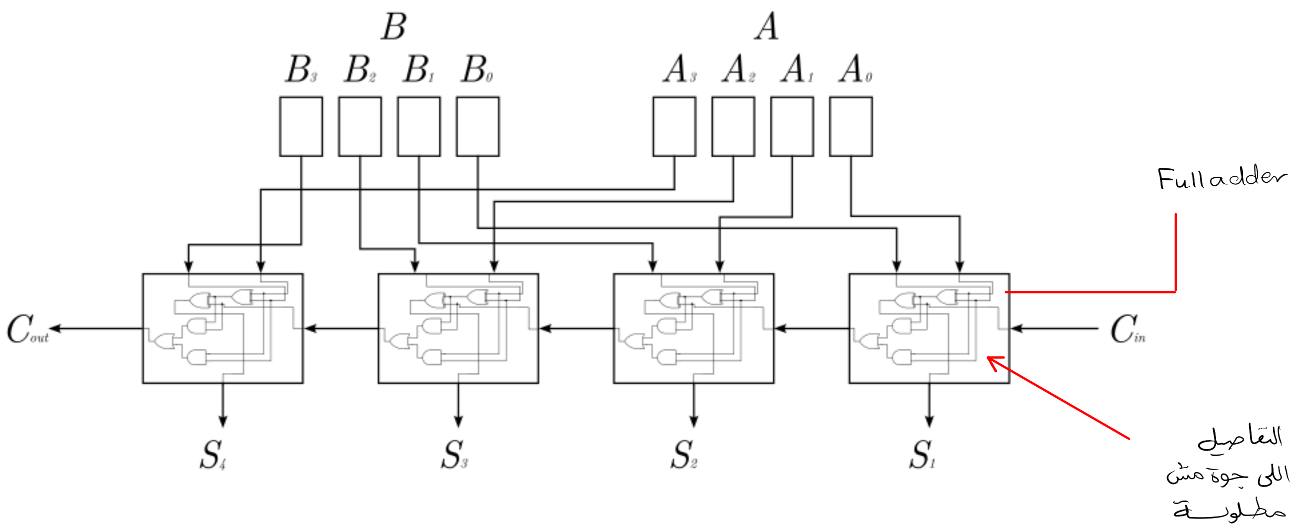
c. F(A,B,C,D)=∏(1,3,,7,9,11,13,14).

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	1	0	1
11	1	0	1	0
10	1	0	0	1

$F(A,B,C,D) = \bar{C}\bar{D} + \bar{B}\bar{D} + \bar{A}B\bar{C} + \bar{A}\bar{D} + ABCD$

$F(A,B,C,D) = (B+\bar{D}).(A+\bar{C}+\bar{D}).(\bar{A}+C+\bar{D}).(\bar{A}+\bar{B}+\bar{C}+D)$

12. Draw 4-bit parallel adder, then show how to convert it to parallel subtractor.



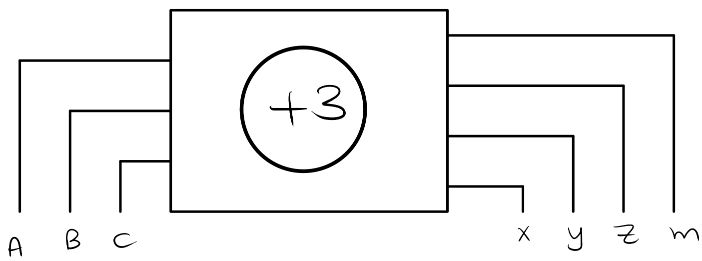
by implementing the equation that says

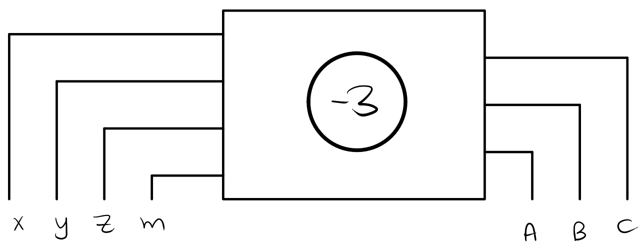
$$A - B = A + \overline{B} + 1$$

we can TransForm it into a 4 bit subtractor by using a Not gate with B inputs assumming A bigger than B and changing the Cin from 0 to 1

---

13. Implement Excess-3 code to encrypt 3 bit number in both transmitter and receiver sides.





A \ BC	00	01	11	10
0	1	0	1	0
1	1	0	1	0

$m = \overline{C}$

$Z = \overline{B}\,\overline{C} + BC$

A \ BC	00	01	11	10
0	0	1	1	1
1	1	0	0	0

$y = \overline{A}C + \overline{A}B + A\overline{B}\,\overline{C}$

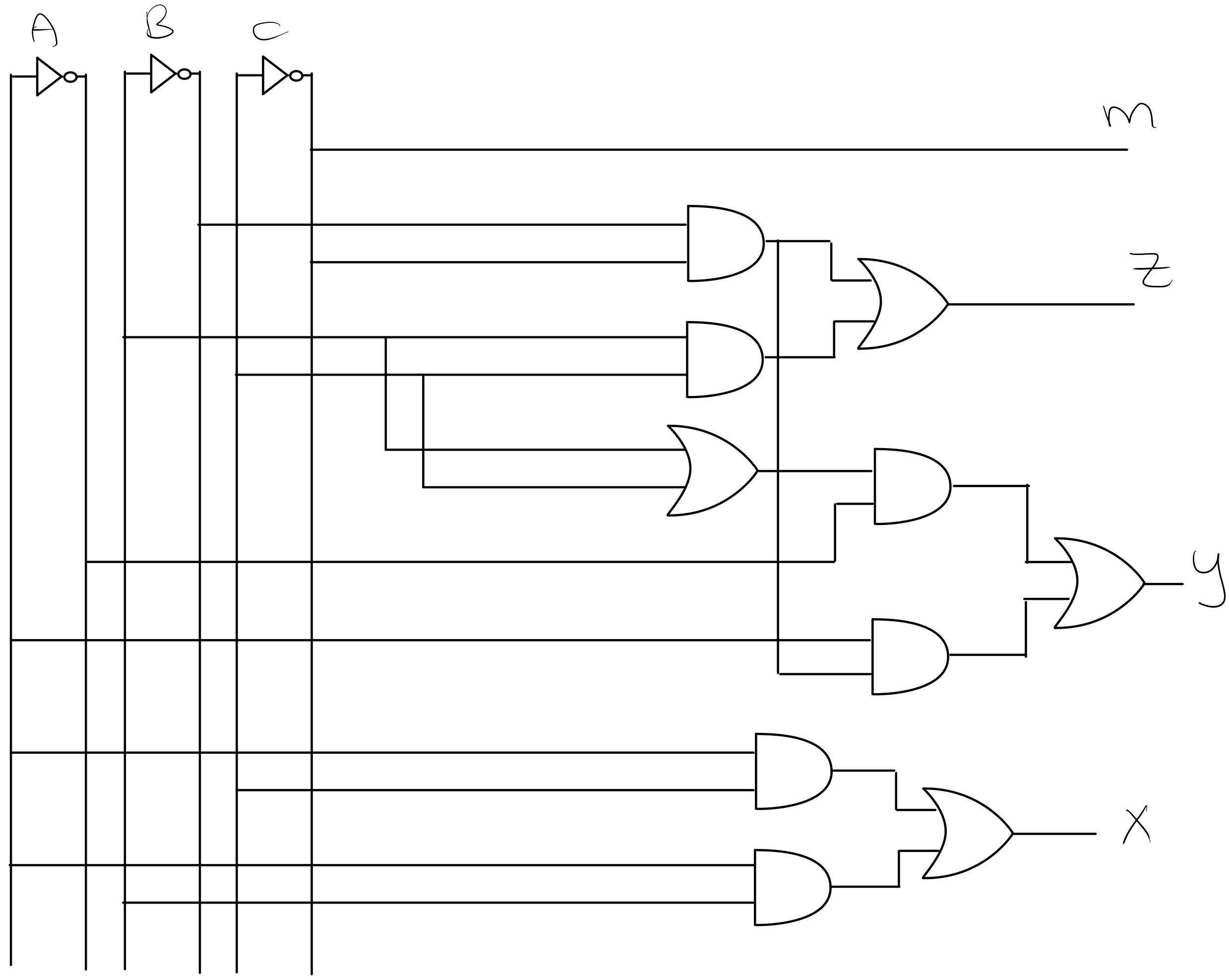
$\overline{A}(B+C) + A.(\overline{B}\,\overline{C})$

A \ BC	00	01	11	10
0	0	0	0	0
1	0	1	1	1

$x = AC + AB$

at Transmitter

A	B	C	x	y	z	m
0	0	0	0	0	1	1
0	0	1	0	1	0	0
0	1	0	0	1	0	1
0	1	1	0	1	1	0
1	0	0	0	1	1	1
1	0	1	1	0	0	0
1	1	0	1	0	0	1
1	1	1	1	0	1	0



$C = \overline{m}$

xy \ zm	00	01	11	10
00	0X	X1	0	1X
01	0	1	0	1
11	0X	X1	X0	1X
10	0	1	X0	1

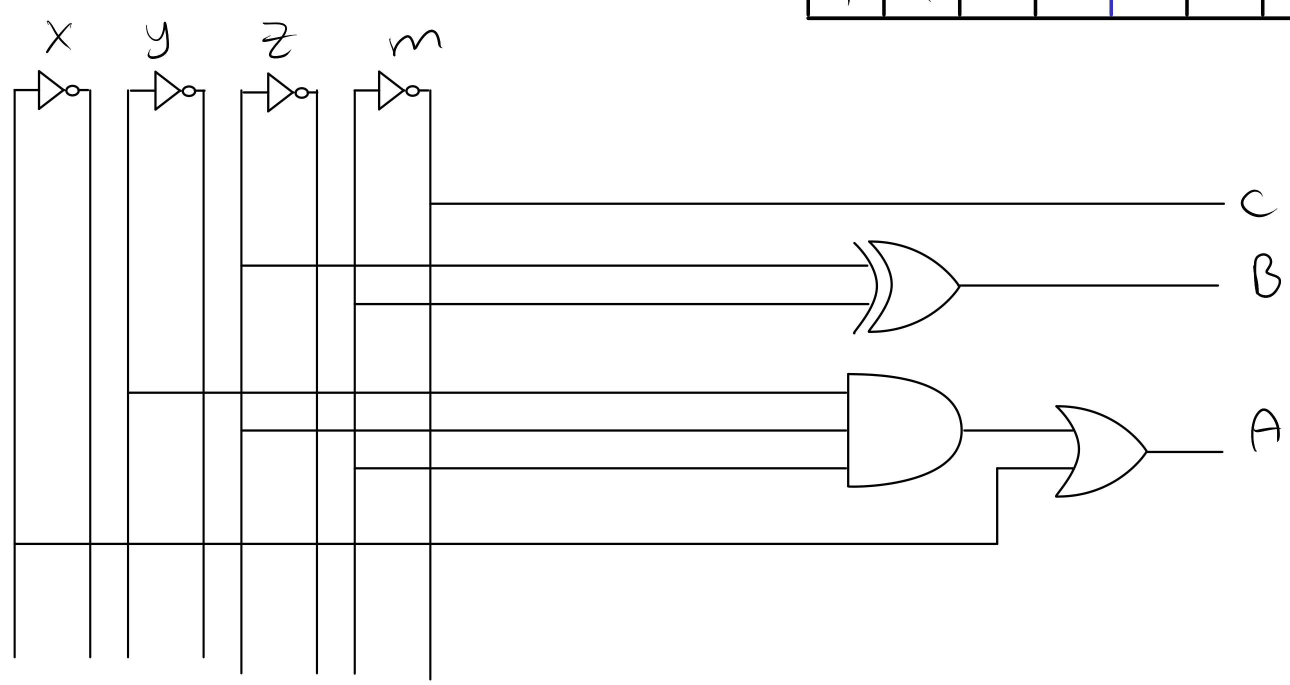
$B = \bar{z}m + \bar{m}z = z \oplus m$

xy \ zm	00	01	11	10
00	X0	X0	0	X0
01	0	0	1	0
11	X1	X1	X1	X1
10	1	1	X	1

$A = x + yzm$

at reciver

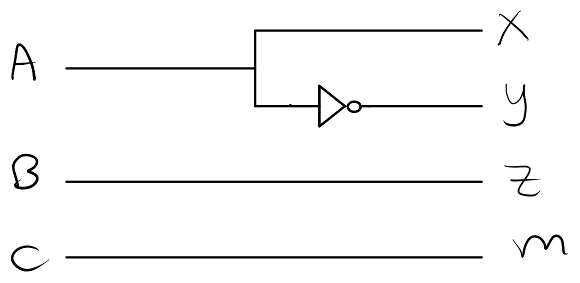
x	y	z	m	A	B	C
0	0	0	0	X	X	X
0	0	0	1	X	X	X
0	0	1	0	X	X	X
0	0	1	1	0	0	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	1
0	1	1	1	1	0	0
1	0	0	0	1	0	1
1	0	0	1	1	1	0
1	0	1	0	1	1	1
1	0	1	1	X	X	X
1	1	0	0	X	X	X
1	1	0	1	X	X	X
1	1	1	0	X	X	X
1	1	1	1	X	X	X



14. Implement Excess-4 code to encrypt 3 bit number in both transmitter and receiver sides.

at Transmitter

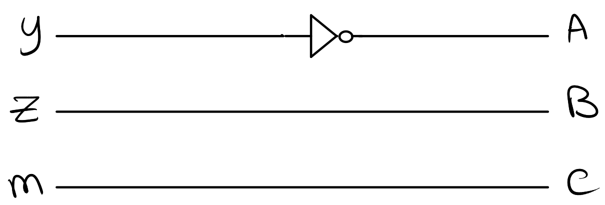
$m = C \quad z = B \quad y = \bar{A} \quad x = A$



A	B	C	x	y	z	m
0	0	0	0	1	0	0
0	0	1	0	1	0	1
0	1	0	0	1	1	0
0	1	1	0	1	1	1
1	0	0	1	0	0	0
1	0	1	1	0	0	1
1	1	0	1	0	1	0
1	1	1	1	0	1	1

at reciver

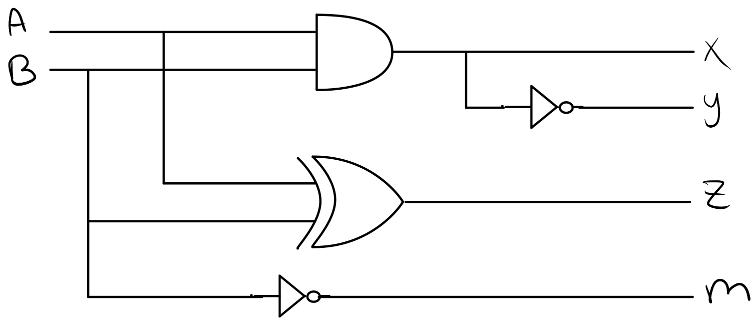
$C = m \quad B = Z \quad A = \bar{y}$



x	y	z	m	A	B	C
0	0	0	0	X	X	X
0	0	0	1	X	X	X
0	0	1	0	X	X	X
0	0	1	1	X	X	X
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	1	0	0
1	0	0	1	1	0	1
1	0	1	0	1	1	0
1	0	1	1	1	1	1
1	1	0	0	X	X	X
1	1	0	1	X	X	X
1	1	1	0	X	X	X
1	1	1	1	X	X	X

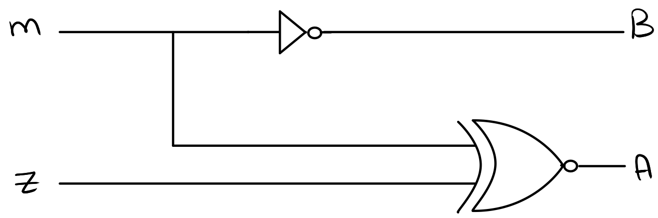
15. Implement Excess-5 code to encrypt 2 bit number in both transmitter and receiver sides.

$m = \overline{B} \quad Z = A \oplus B \quad y = (AB)' \quad X = AB$



A	B	X	y	Z	m
0	0	0	1	0	1
0	1	0	1	1	0
1	0	0	1	1	1
1	1	1	0	0	0

$B = \overline{m} \qquad A = Z \odot m$



X	y	Z	m	A	B
0	1	0	1	0	0
0	1	1	0	0	1
0	1	1	1	1	0
1	0	0	0	1	1

صلِّ على رسول الله

16. Implement Excess-2 code to encrypt BCD number (0→9) in both transmitter and receiver side.

$D = m \qquad C = \bar{z}$

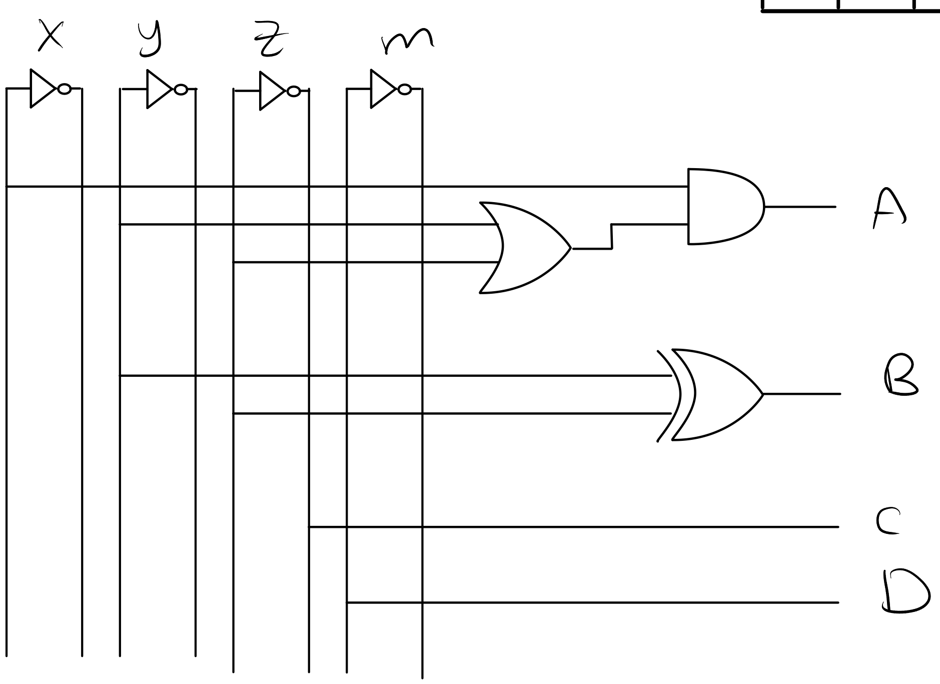
xy \ zm	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	X	X	X	X
10	0	0	X	1

$B = y\bar{z} + \bar{y}z = z \oplus y$

xy \ zm	00	01	11	10
00	0	0	0	0
01	0	0	1	1
11	X	X	X	X
10	1	1	X	X

$A = x + yz$

x	y	z	m	A	B	C	D	
0	0	0	0	0	0	1	0	
0	0	0	1	0	0	1	1	
0	0	1	0	0	1	0	0	
0	0	1	1	0	1	0	1	
0	1	0	0	0	1	1	0	
0	1	0	1	0	1	1	1	
0	1	1	0	1	0	0	0	
0	1	1	1	1	0	0	1	
1	0	0	0	1	0	1	0	
1	0	0	1	1	0	1	1	
1	0	1	0	X	X	X	X	0
1	0	1	1	X	X	X	X	1
1	1	0	0	X	X	X	X	0
1	1	0	1	X	X	X	X	1
1	1	1	0	X	X	X	X	0
1	1	1	1	X	X	X	X	1



$m = D$ $\quad z = \overline{C}$

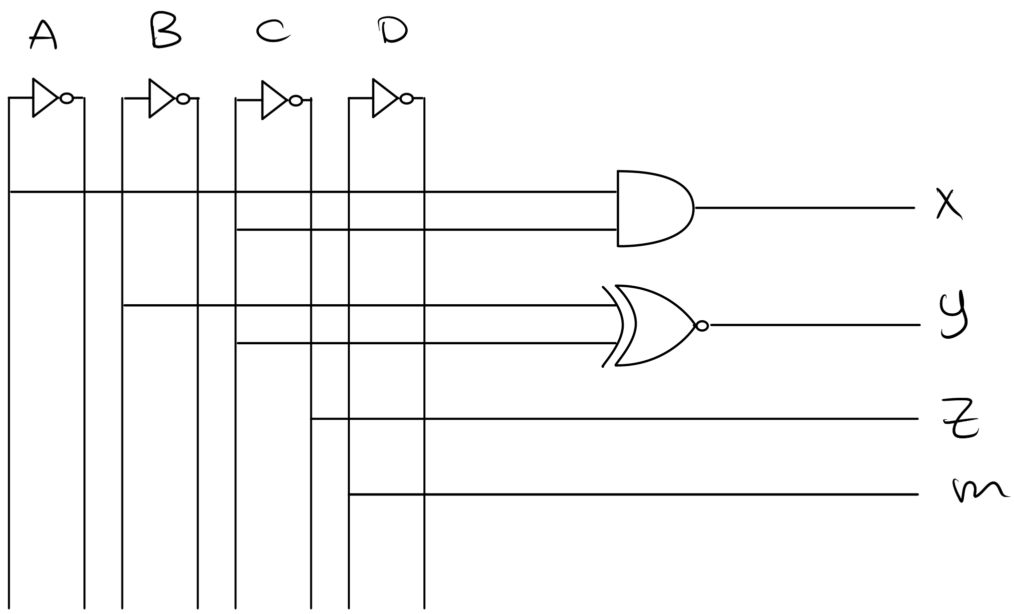
AB \ CD	00	01	11	10
00	X	X	0	0
01	0	0	1	1
11	X	X	X	X
10	1	1	0	0

$y = \overline{B}\,\overline{C} + BC = B \odot C$

AB \ CD	00	01	11	10
00	X	X	0	0
01	0	0	0	0
11	X	X	X	X
10	0	0	1	1

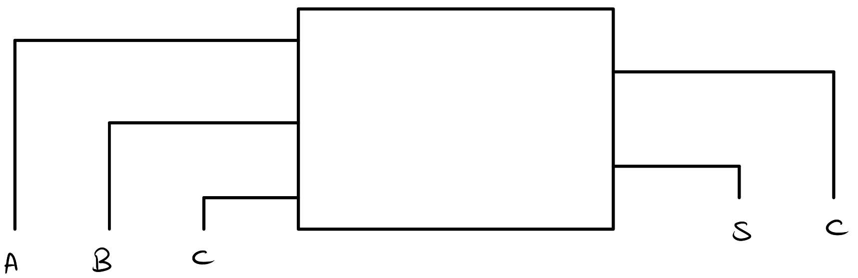
$x = AC$

A	B	C	D	x	y	z	m	
0	0	0	0	X	X	X	X	0
0	0	0	1	X	X	X	X	1
0	0	1	0	0	0	0	0	
0	0	1	1	0	0	0	1	
0	1	0	0	0	0	1	0	
0	1	0	1	0	0	1	1	
0	1	1	0	0	1	0	0	
0	1	1	1	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	0
1	0	1	1	1	0	0	1	1
1	1	0	0	X	X	X	X	0
1	1	0	1	X	X	X	X	1
1	1	1	0	X	X	X	X	0
1	1	1	1	X	X	X	X	1



17. Design:

a. Full Adder circuit.



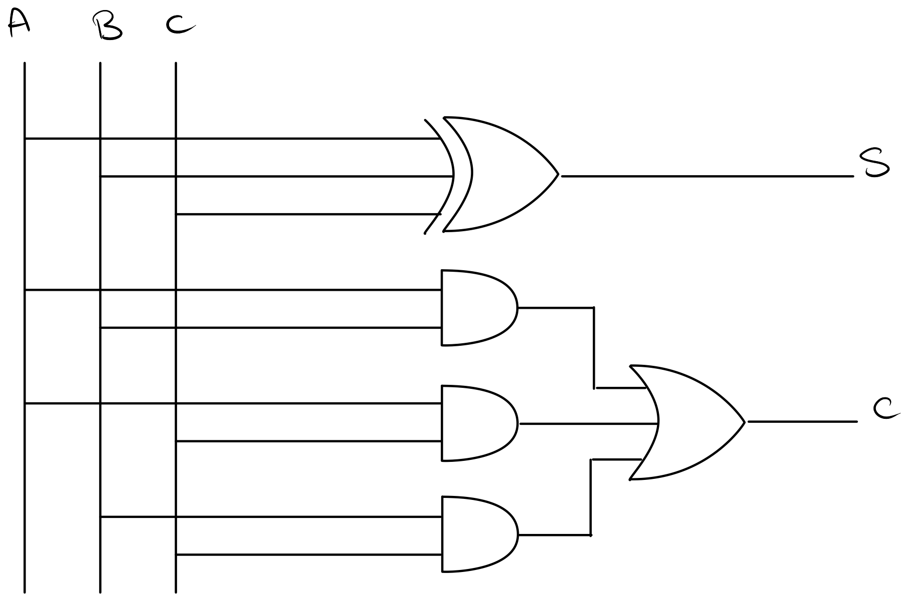
A \ BC	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$S = A \oplus B \oplus C$

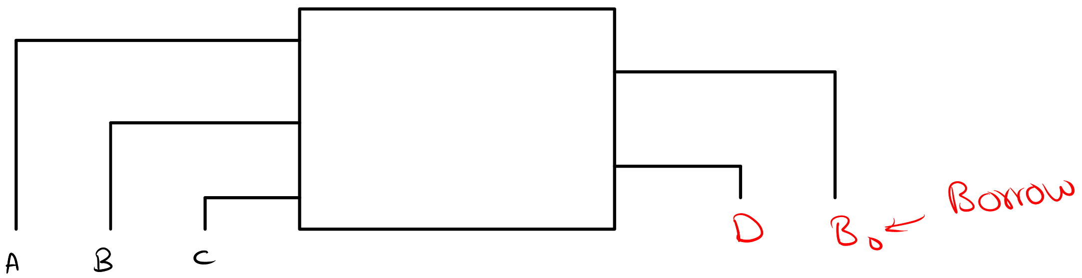
A \ BC	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$C_{out} = BC + AC + AB$

A	B	C_{in}	C_{out}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



b. Full Subtractor circuit.



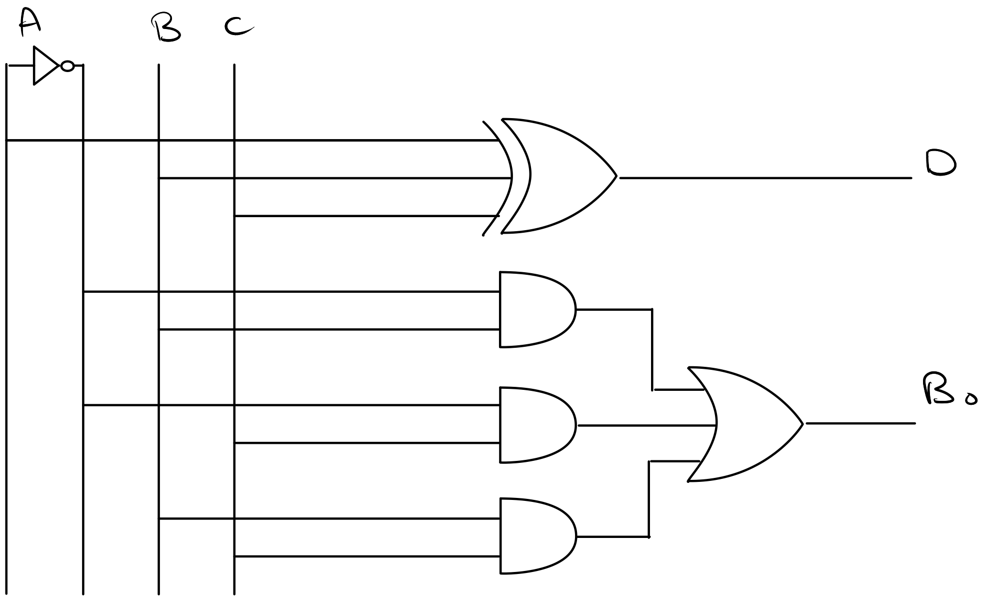
A \ B_o C	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$$D = A \oplus B \oplus C$$

A \ B_o C	00	01	11	10
0	0	1	1	1
1	0	0	1	0

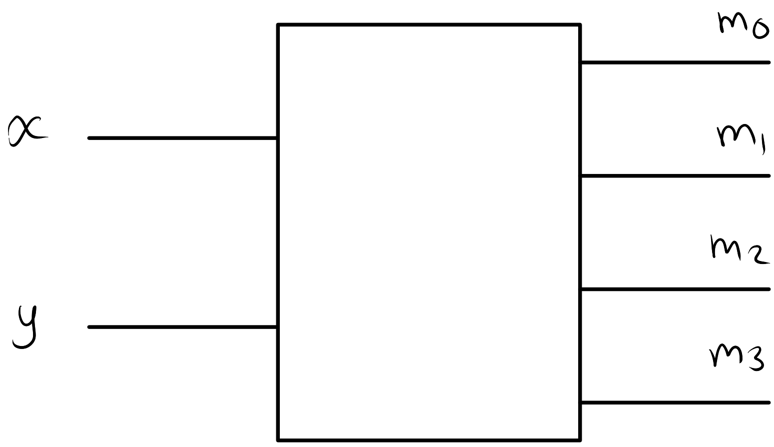
$$B_o = \bar{A}C + BC + \bar{A}B$$

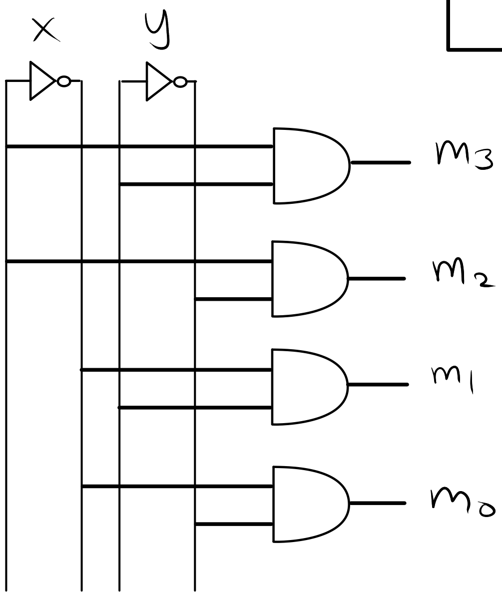
A	B	C	D	B_o
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1



if you want to understand Truth table

c. 2X4 decoder.

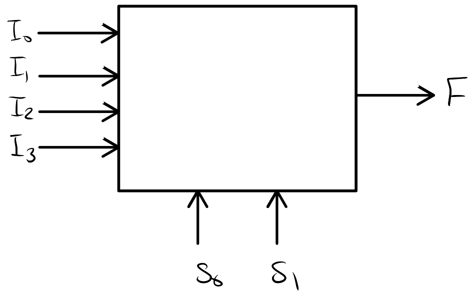




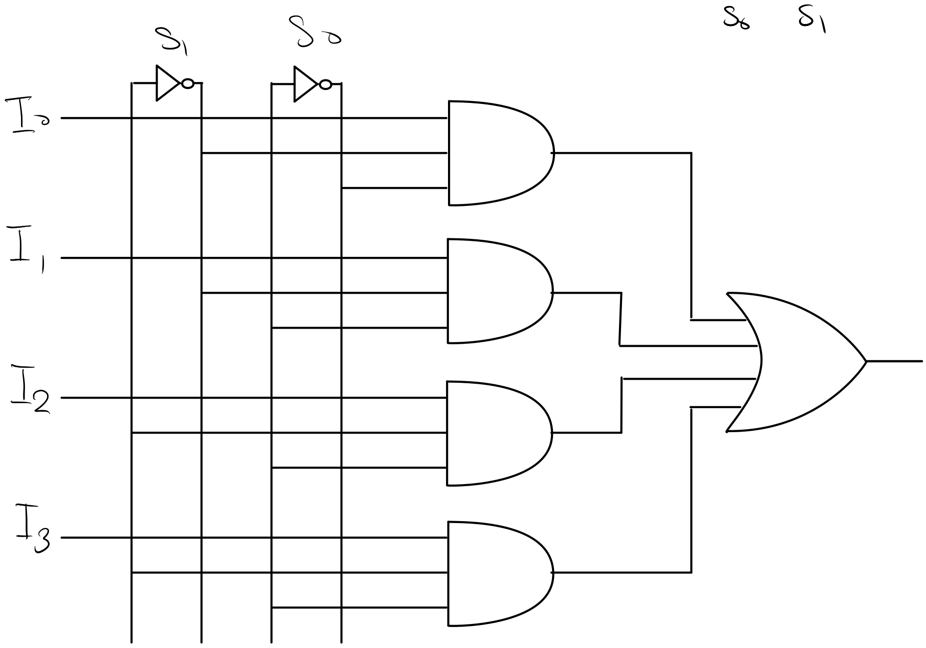
x	y	D_0	D_1	D_2	D_3	
0	0	1	0	0	0	$\bar{x}\bar{y}$
0	1	0	1	0	0	$\bar{x}y$
1	0	0	0	1	0	$x\bar{y}$
1	1	0	0	0	1	xy

d.4X1 Multiplexer.

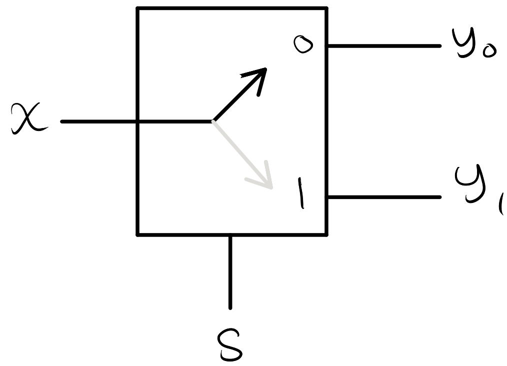
$$F = I_0\bar{S}_1\bar{S}_0 + I_1\bar{S}_1 S_0 + I_2 S_1\bar{S}_0 + I_3 S_1 S_0$$



S_1	S_0	F
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

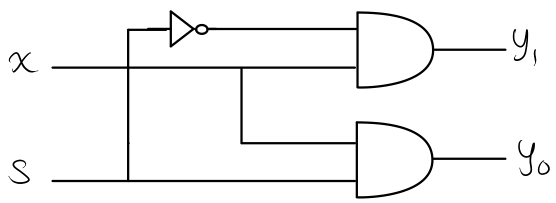


e. 1X2 Demultiplexer.

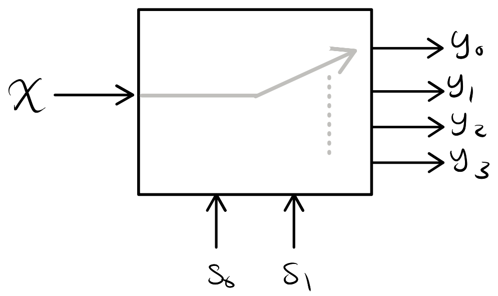


S	y_1	y_0
0	0	x
1	x	0

$$y_1 = Sx$$
$$y_0 = \overline{S}x$$

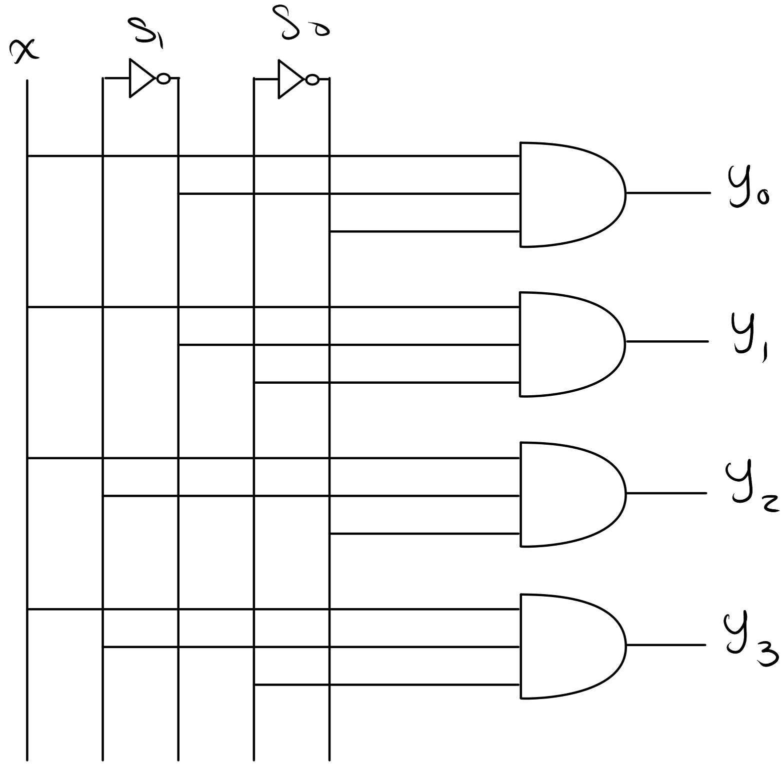


f. 1X4 Demultiplexer.

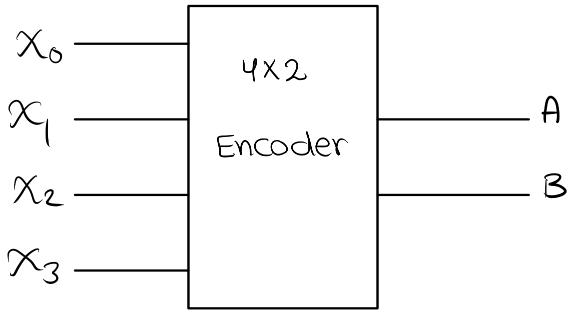


S_1	S_0	y_3	y_2	y_1	y_0
0	0	0	0	0	x
0	1	0	0	x	0
1	0	0	x	0	0
1	1	x	0	0	0

$$y_3 = S_1 S_0 x$$
$$y_2 = S_1 \overline{S_0} x$$
$$y_1 = \overline{S_1} S_0 x$$
$$y_0 = \overline{S_1}\,\overline{S_0}\, x$$



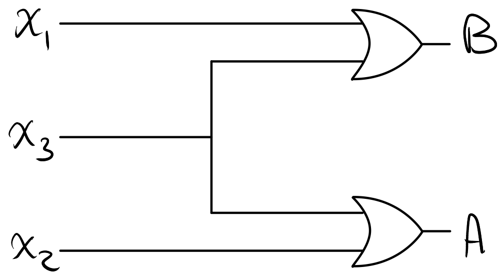
g. 4X2 Enscoder.



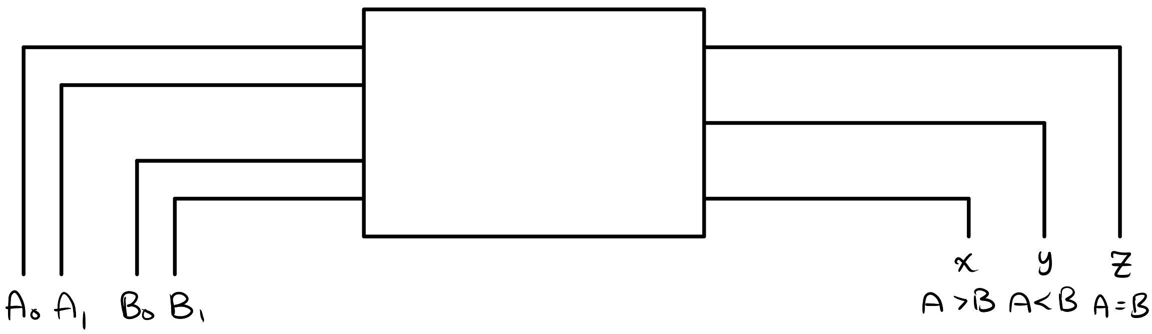
X_3	X_2	X_1	X_0	A	B
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1

$$A = X_2 + X_3$$

$$B = X_1 + X_3$$



h. 2-bit Comparator.



A_1	A_0	B_1	B_0	x	y	z
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	0	1

$A_1 A_0$ \ $B_1 B_0$	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	1	0	1
10	1	1	0	0

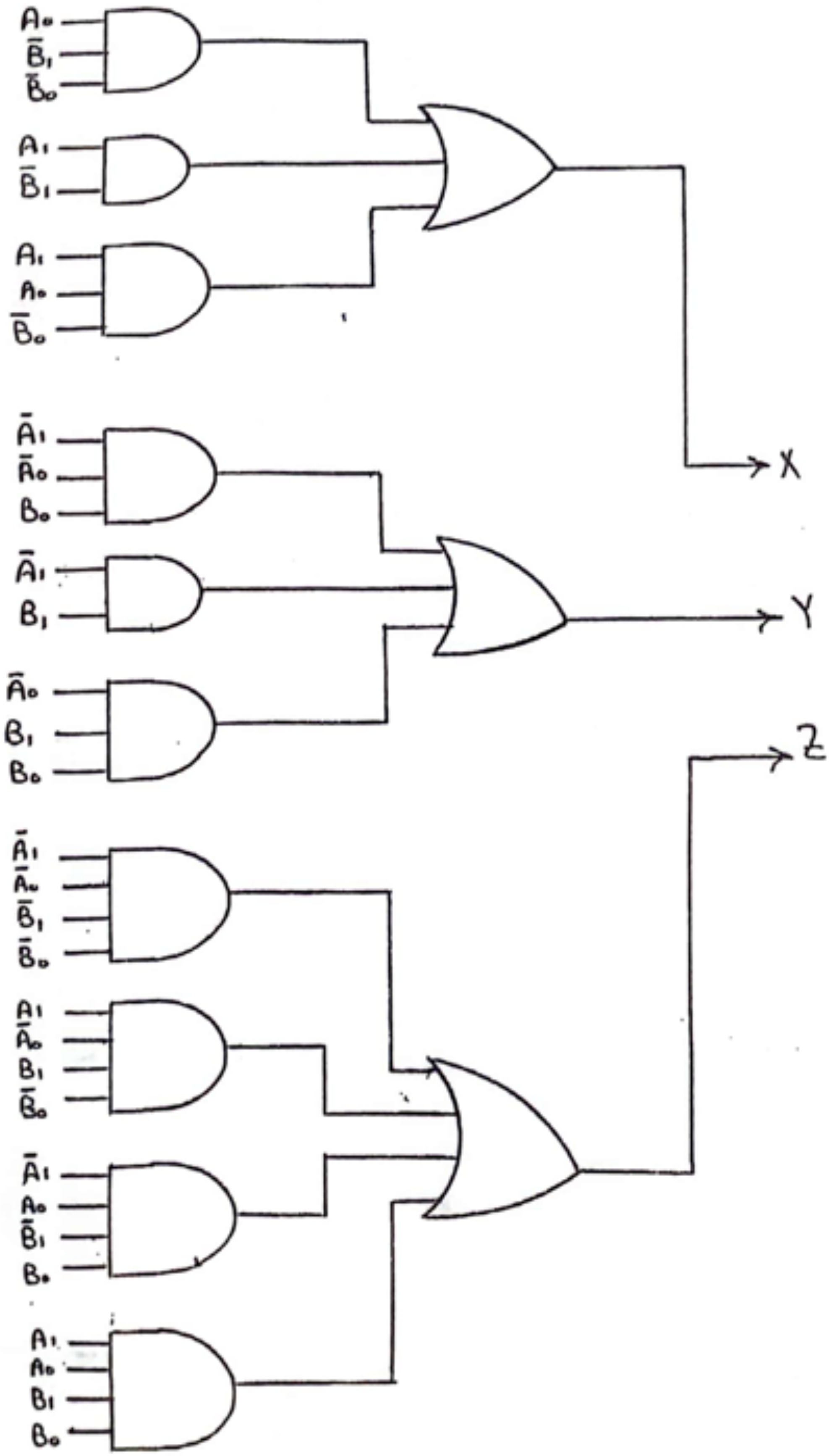
$$x = A_1\overline{B_1} + A_1A_0\overline{B_0} + A_0\overline{B_1}\,\overline{B_0}$$

$A_1 A_0$ \ $B_1 B_0$	00	01	11	10
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	1	0

$$y = \overline{A_1}B_1 + \overline{A_1}\,\overline{A_0}B_0 + A_0B_1B_0$$

$A_1 A_0$ \ $B_1 B_0$	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
10	0	0	0	1

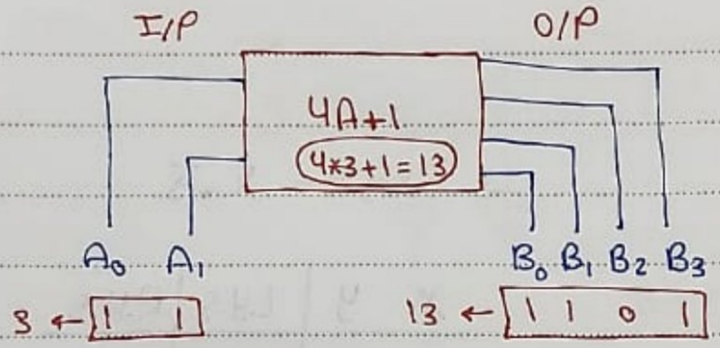
$$z = \overline{A_1}\,\overline{A_0}\,\overline{B_1}\,\overline{B_0} + \overline{A_1}A_0\overline{B_1}B_0 + A_1A_0B_1B_0 + A_1\overline{A_0}B_1\overline{B_0}$$



A_0
$\bar{B}_1$
$\bar{B}_0$
A_1
$\bar{B}_1$
A_1
A_0
$\bar{B}_0$
X
$\bar{A}_1$
$\bar{A}_0$
B_0
$\bar{A}_1$
B_1
Y
$\bar{A}_0$
B_1
B_0
Z
$\bar{A}_1$
$\bar{A}_0$
$\bar{B}_1$
$\bar{B}_0$
A_1
$\bar{A}_0$
B_1
$\bar{B}_0$
$\bar{A}_1$
A_0
$\bar{B}_1$
B_0
A_1
A_0
B_1
B_0

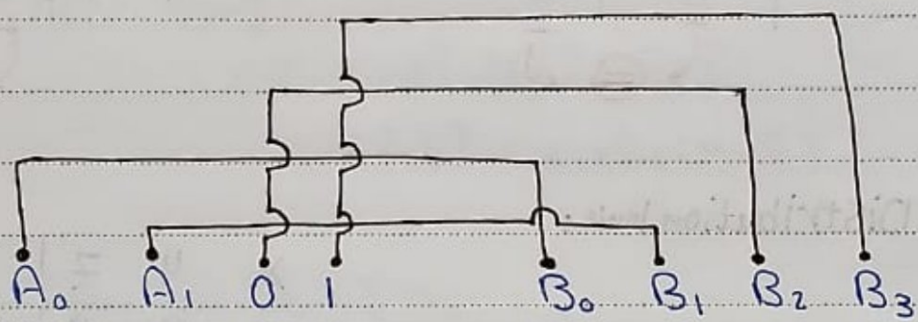
Note .   / /

(i)- A Circuit that accepts 2-bit number (A), the output is (4A+1):

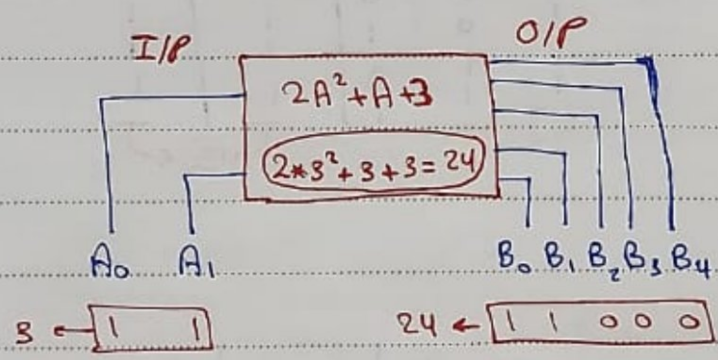


A_0	A_1	B_0	B_1	B_2	B_3
0	0	0	0	0	1
0	1	0	1	0	1
1	0	1	0	0	1
1	1	1	1	0	1

$\boxed{B_0 = A_0}$ $\boxed{B_1 = A_1}$ $\boxed{B_2 = 0}$ $\boxed{B_3 = 1}$

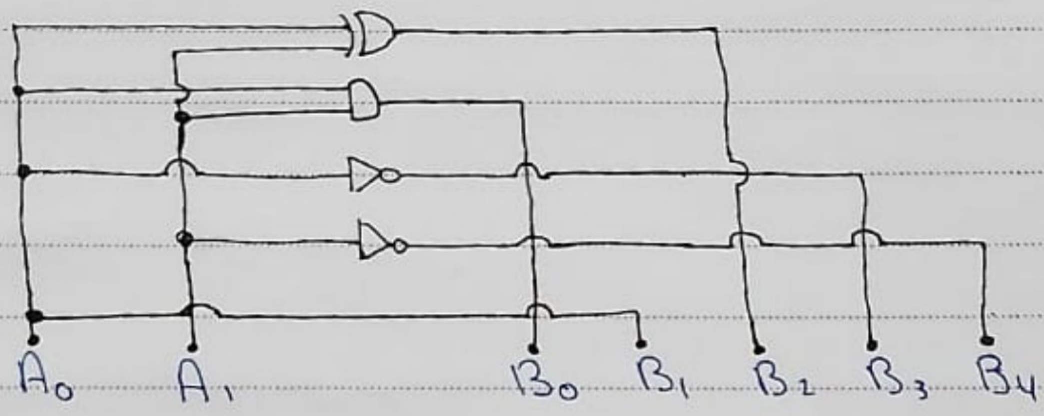


(J)- A Circuit that accepts 2-bit number (A), the output is $(2A^2+A+3)$:

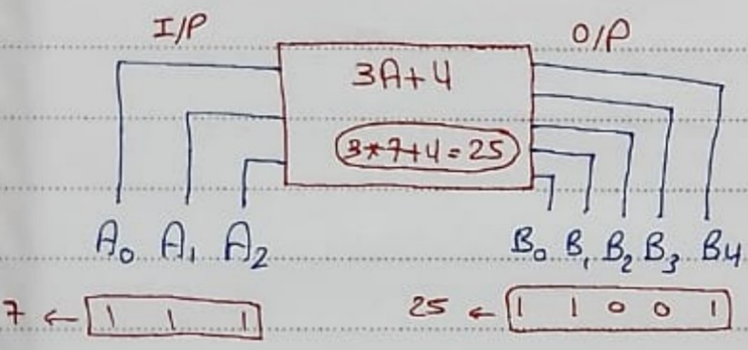


A_0	A_1	B_0	B_1	B_2	B_3	B_4
0	0	0	0	0	1	1
0	1	0	0	1	1	0
1	0	0	1	1	0	1
1	1	1	1	0	0	0

$\boxed{B_0 = A_0 \cdot A_1}$, $\boxed{B_1 = A_0}$, $\boxed{B_2 = A_0 \oplus A_1}$, $\boxed{B_3 = \overline{A_0}}$, $\boxed{B_4 = \overline{A_1}}$



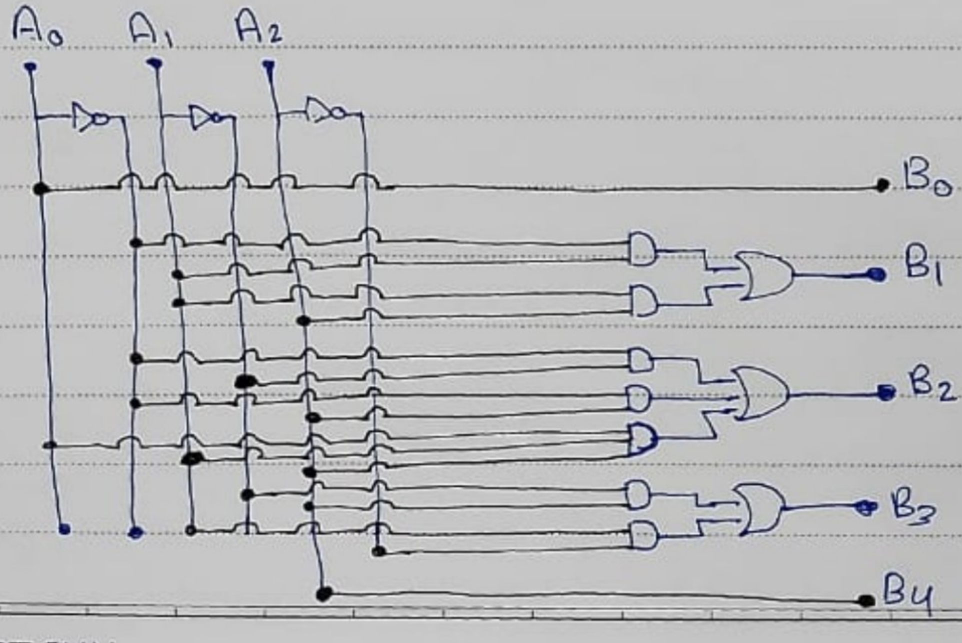
Ⓚ- A circuit that accepts 3-bit number (A), the output is : (3A + 4) :



A_0	A_1	A_2	B_0	B_1	B_2	B_3	B_4
0	0	0	0	0	1	0	0
0	0	1	0	0	1	1	1
0	1	0	0	1	0	1	0
0	1	1	0	1	1	0	1
1	0	0	1	0	0	0	0
1	0	1	1	0	0	1	1
1	1	0	1	0	1	1	0
1	1	1	1	1	0	0	1

$\boxed{B_0 = A_0}$, $\boxed{B_1 = \overline{A_0}A_1 + A_1A_2}$, $\boxed{B_2 = \overline{A_0}\,\overline{A_1} + \overline{A_0}A_2 + A_0A_1\overline{A_2}}$, $\boxed{B_3 = \overline{A_1}A_2 + A_1\overline{A_2}}$,

$\boxed{B_4 = A_2}$



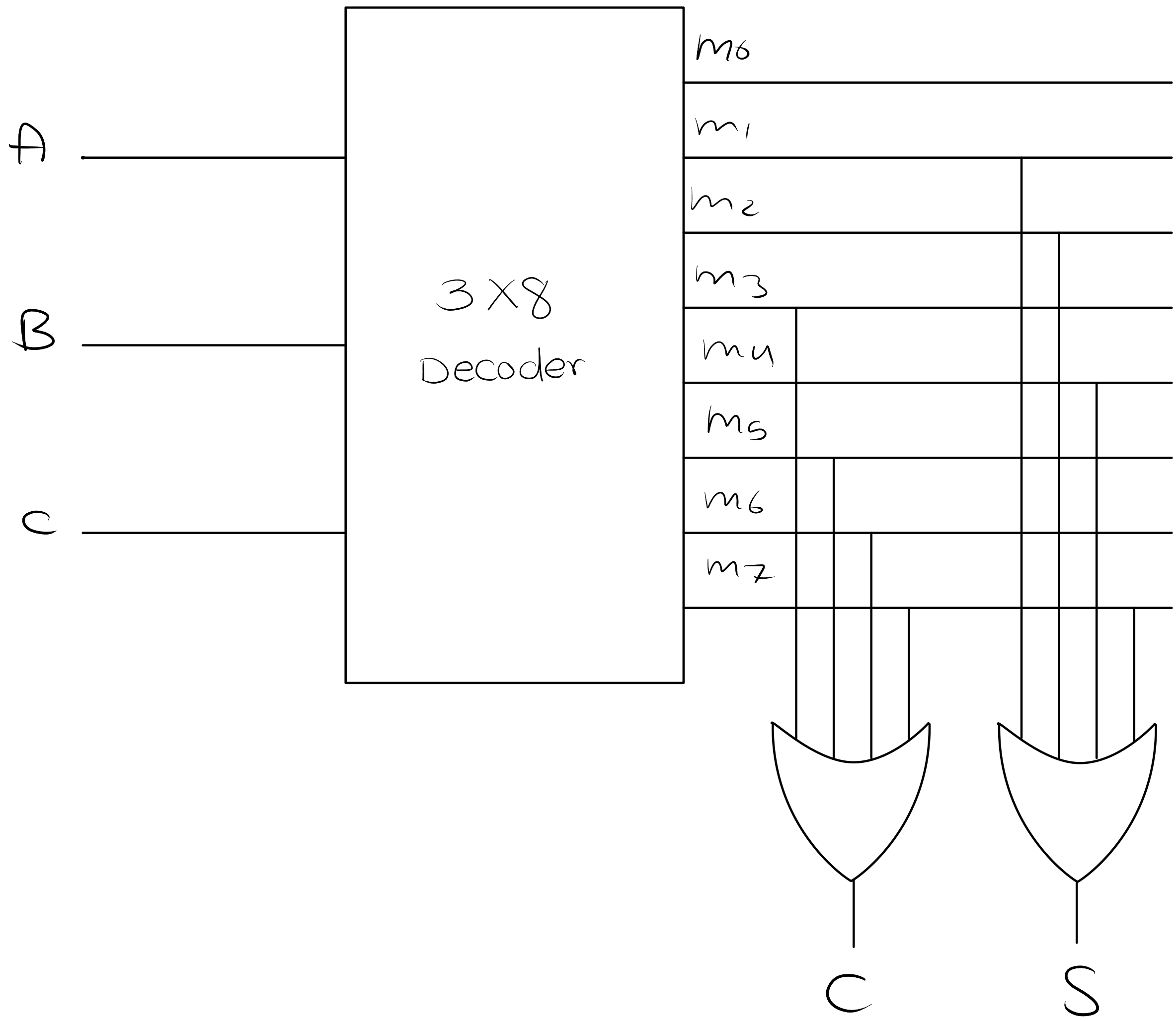
18. Using Decoder and OR gates, implement the following circuits:

a. Full Adder circuit.

A	B	C_{in}	C_{out}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

$$C_{out} = m_3 + m_5 + m_6 + m_7$$

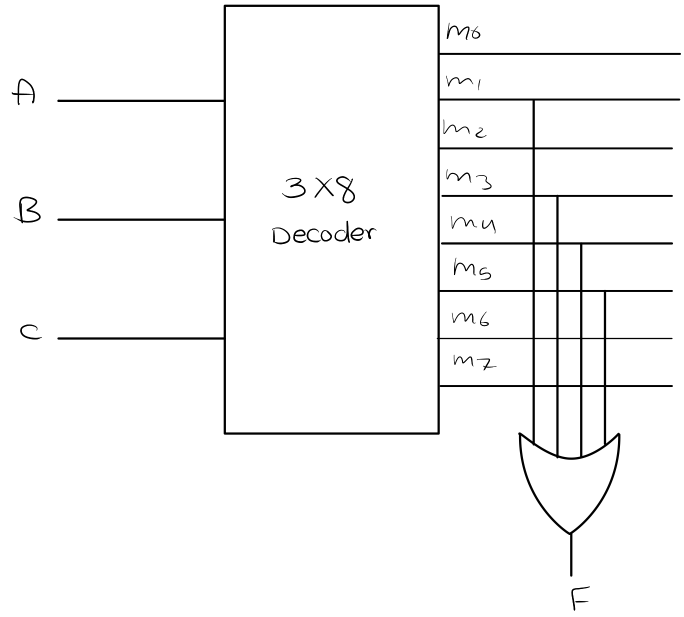
$$S = m_1 + m_2 + m_4 + m_7$$



b. F(A, B, C)=AB'+CA'

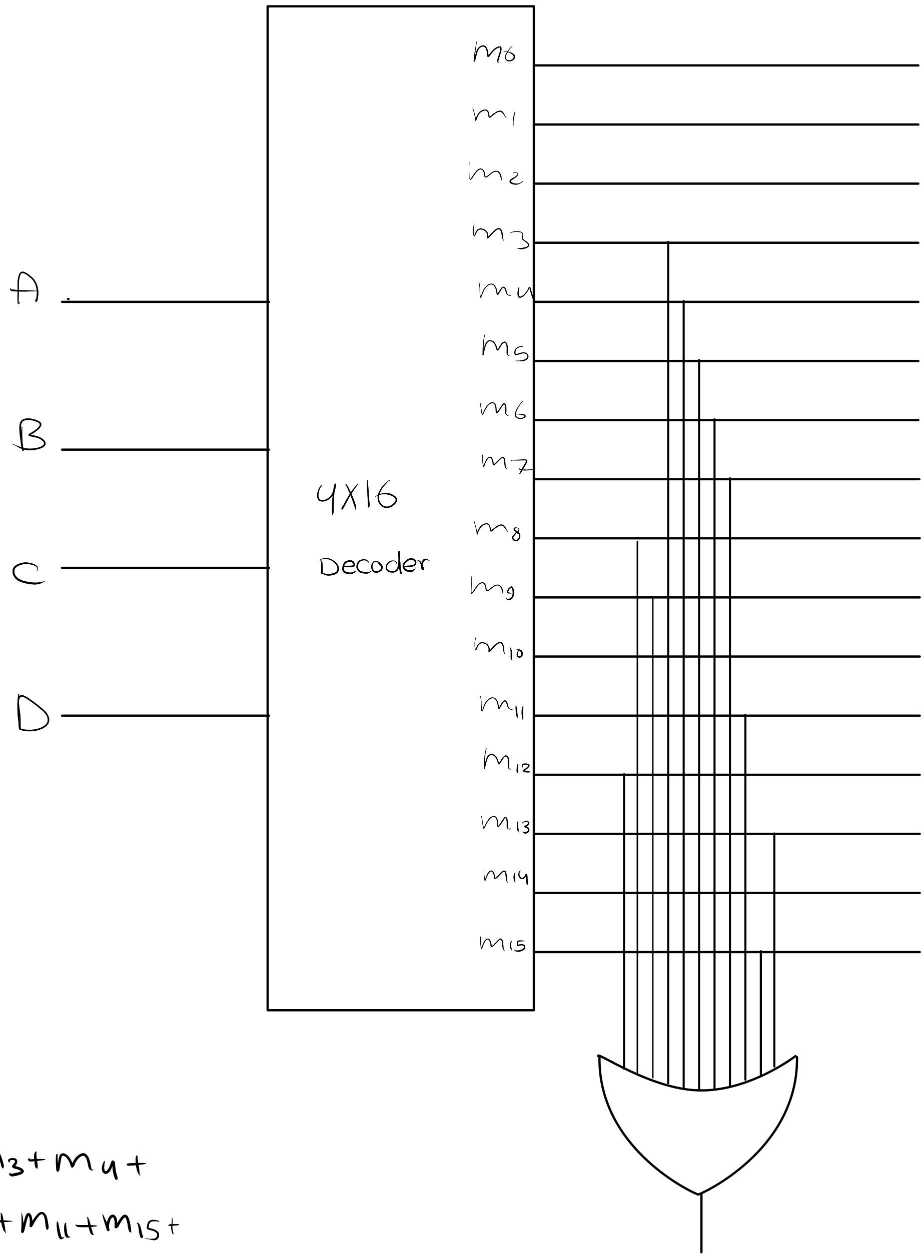
A \ BC	00	01	11	10
0	m_0	m_1 1	m_3 1	m_2
1	m_4 1	m_5 1		

$$F(A,B,C) = m_1 + m_3 + m_4 + m_5$$



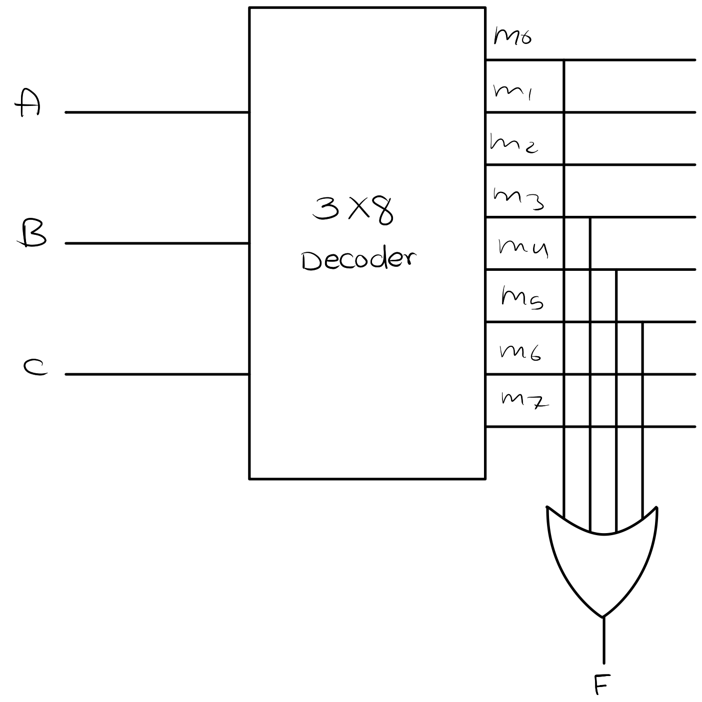
c. F(A, B, C, D)=A'B+AC'+CD

AB \ CD	00	01	11	10
00	0	1	3: 1	2
01	4: 1	5: 1	7: 1	6: 1
11	12: 1	13: 1	15: 1	14
10	8: 1	9: 1	11: 1	10

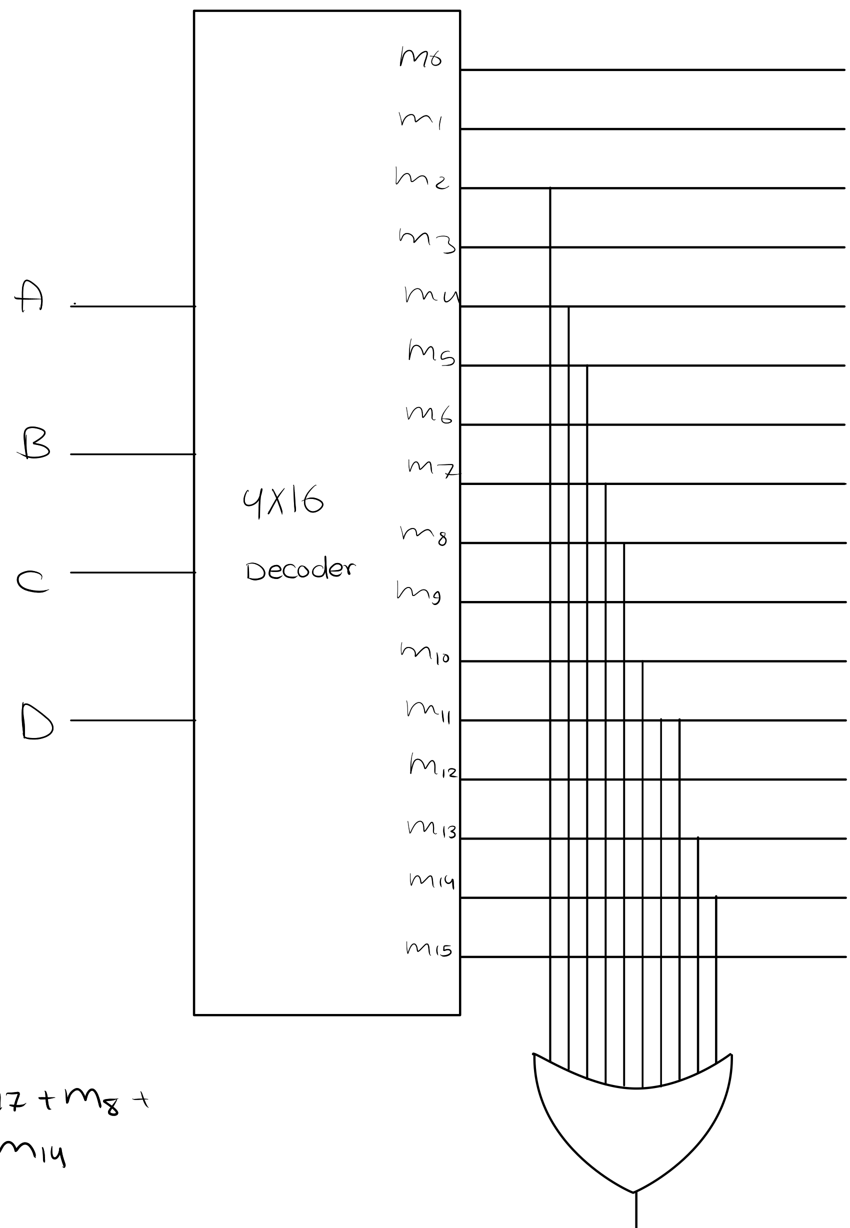


$$F(A,B,C,D) = m_{12} + m_{13} + m_3 + m_4 + m_5 + m_6 + m_7 + m_{11} + m_{15} + m_8 + m_9$$

d. $F(A, B, C)=\sum(0,3,4,5)$.

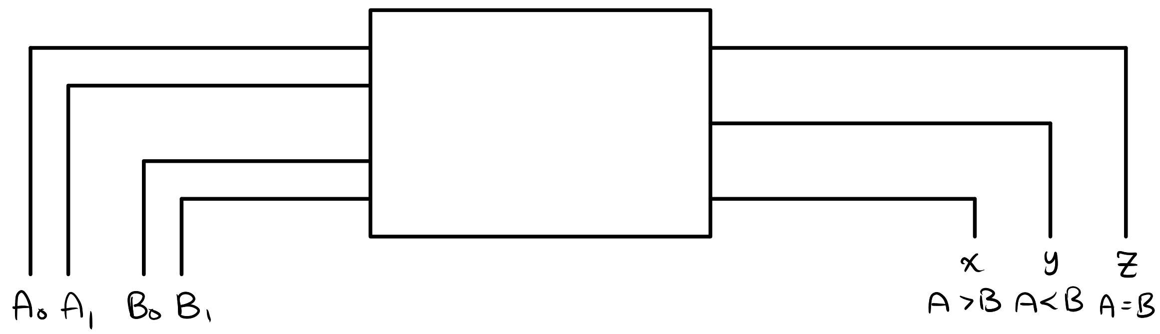


f. $F(A, B, C, D)=\prod(0,1,3,6,9,12,15)$.



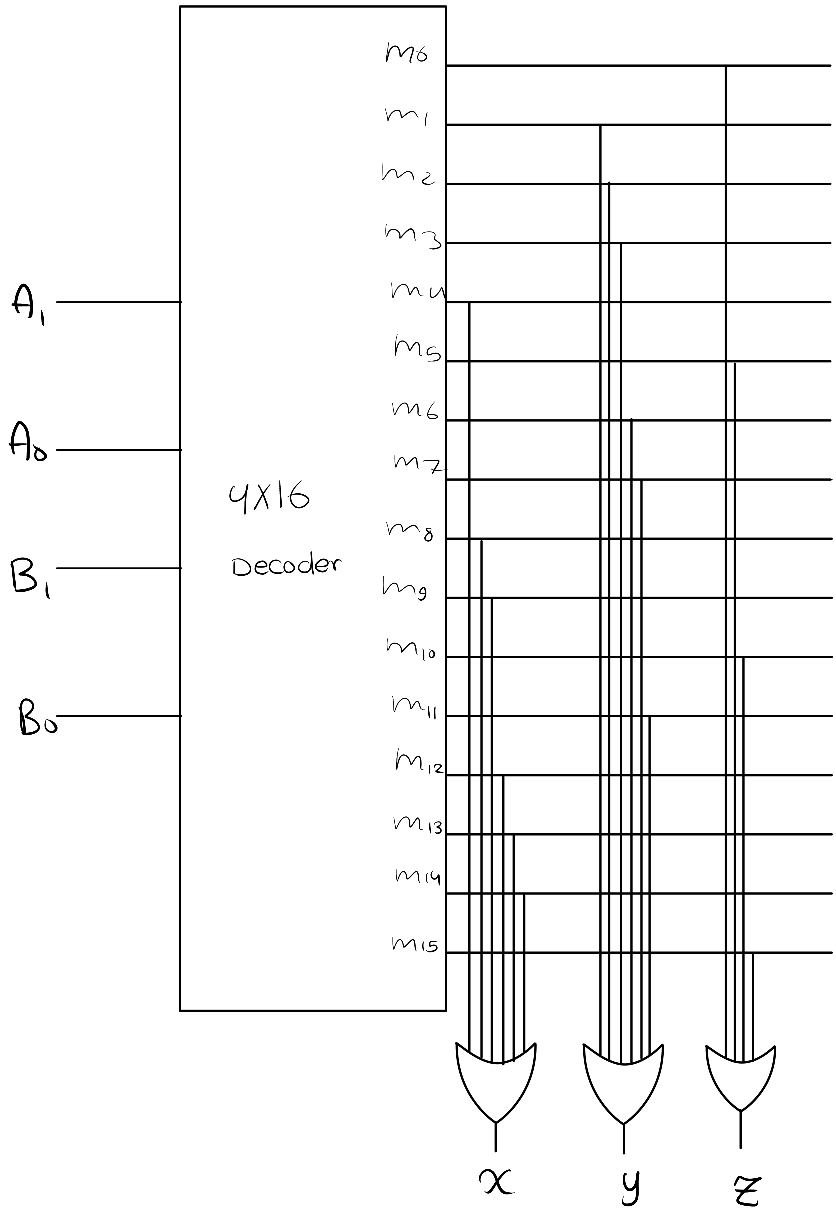
$f(A, B, C, D) = m_2 + m_4 + m_5 + m_7 + m_8 + m_{10} + m_{11} + m_{13} + m_{14}$

g. 2-bit magnitude comparator.



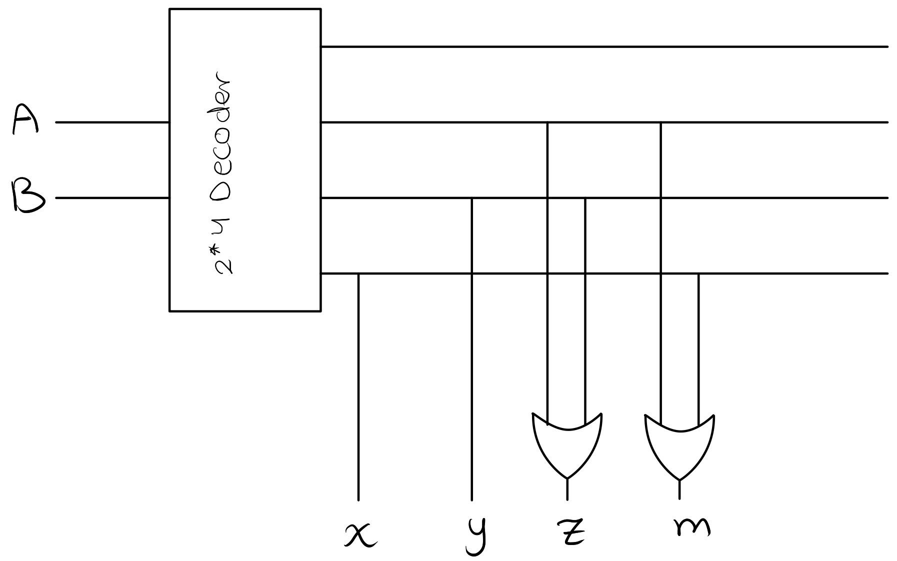
A_1	A_0	B_1	B_0	x	y	z
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	0	1

متنساش تكتب
معادلاتهم



h. A logic circuit that accepts two bit number, then multiply it by 3.

A	B	x	y	z	m
0	0	0	0	0	0
0	1	0	0	1	1
1	0	0	1	1	0
1	1	1	0	0	1



i. A logic circuit that accepts BCD number, then multiply it by 2.

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

$x = m_8 + m_9$

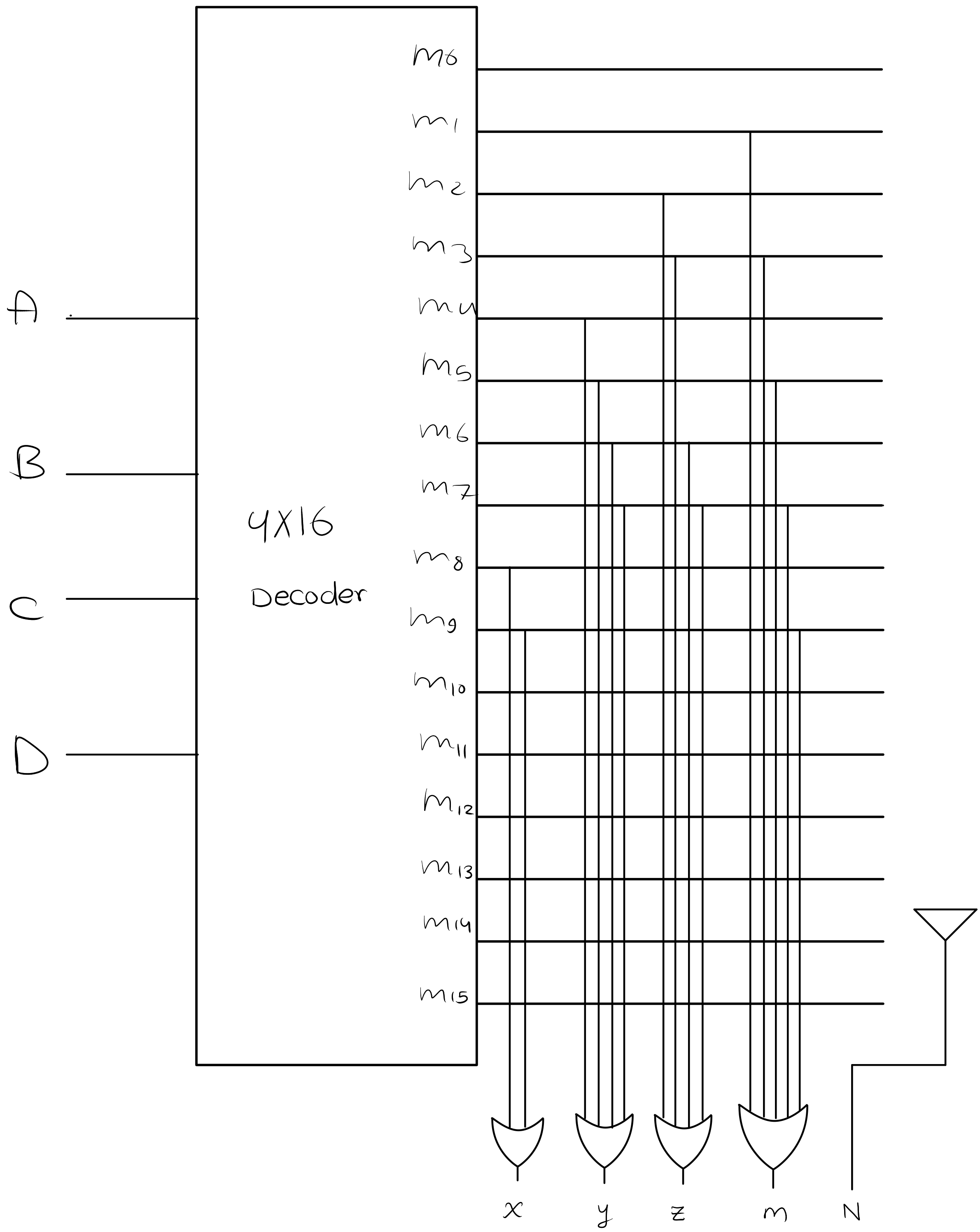
$y = m_4 + m_5 + m_6 + m_7$

$z = m_2 + m_3 + m_6 + m_7$

$m = m_1 + m_3 + m_5 + m_7 + m_9$

$N = 0$

عاداتنا بنعمل Decoder د خليهم كلهم اصفار


A
B
C
D
4X16
Decoder
m0
m1
m2
m3
m4
m5
m6
m7
m8
m9
m10
m11
m12
m13
m14
m15
x
y
z
m
N

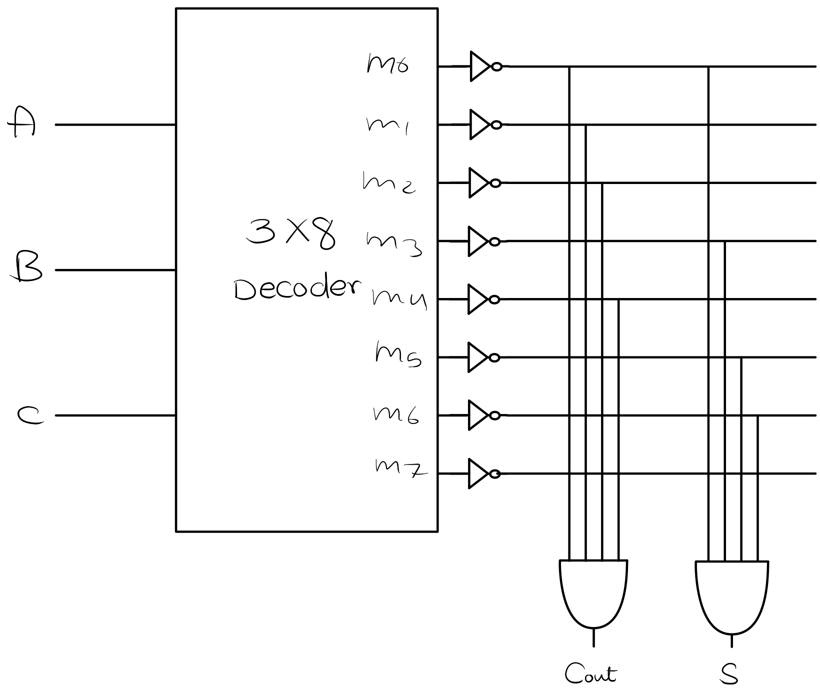
19. Using Decoder and AND gates, implement the following circuits:

a. Full adder circuit.

A	B	C_{in}	C_{out}	S	
0	0	0	0	0	0
0	0	1	0	1	1
0	1	0	0	1	2
0	1	1	1	0	3
1	0	0	0	1	4
1	0	1	1	0	5
1	1	0	1	0	6
1	1	1	1	1	7

$C_{out} = M_0 \cdot M_1 \cdot M_2 \cdot M_4$

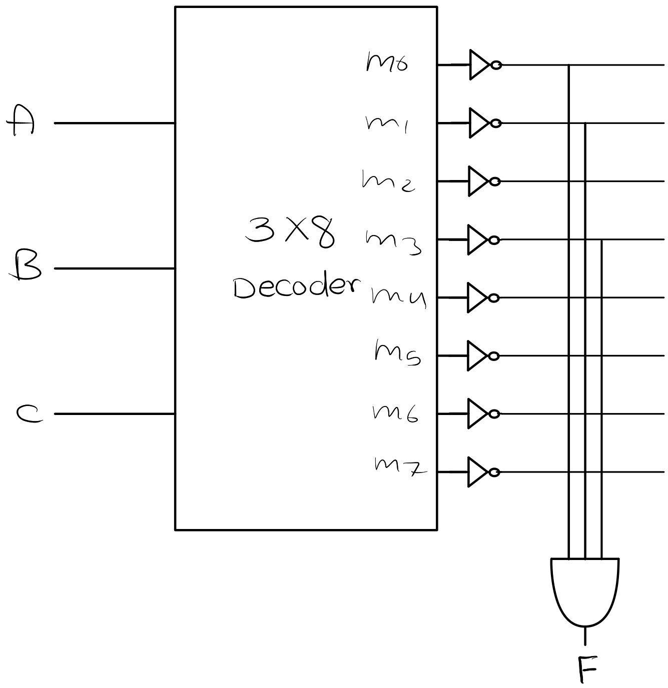
$S = M_0 \cdot M_3 \cdot M_5 \cdot M_6$



b. F(A, B, C)=AB'+CA+B'C.

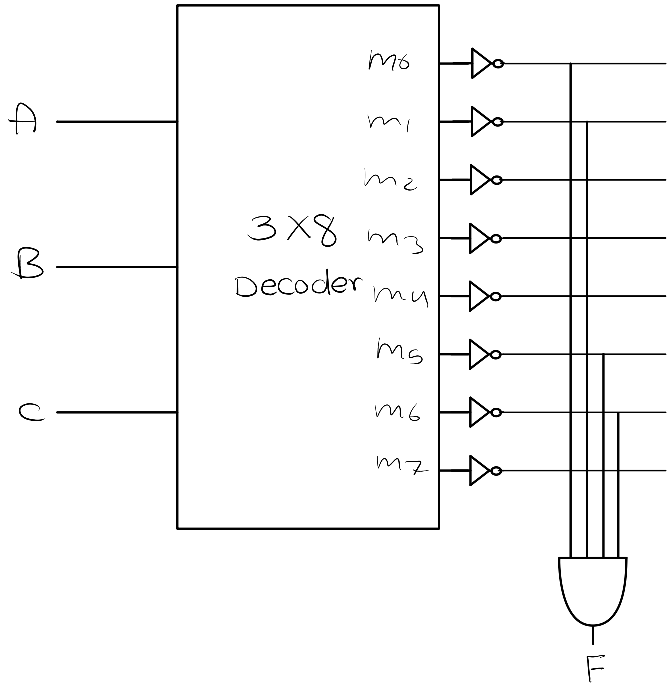
A \ BC	00	01	11	10
0	m_0 0	m_1 0	m_3 0	m_2 1
1	m_4 1	m_5 1	1	1

$F(A,B,C) = M_0 \cdot M_1 \cdot M_3$

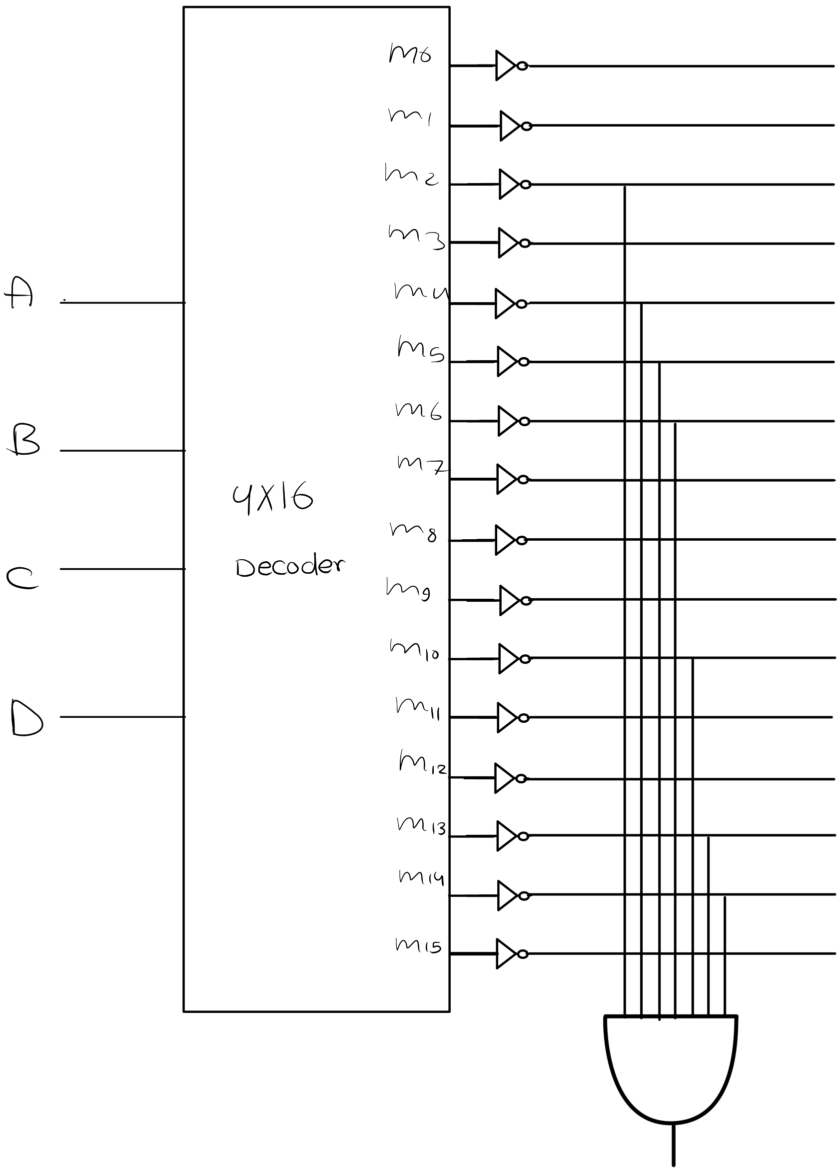


c. F(A, B, C)=$\sum(2,3,4,7)$.

$F(A,B,C) = \prod(0,1,5,6)$

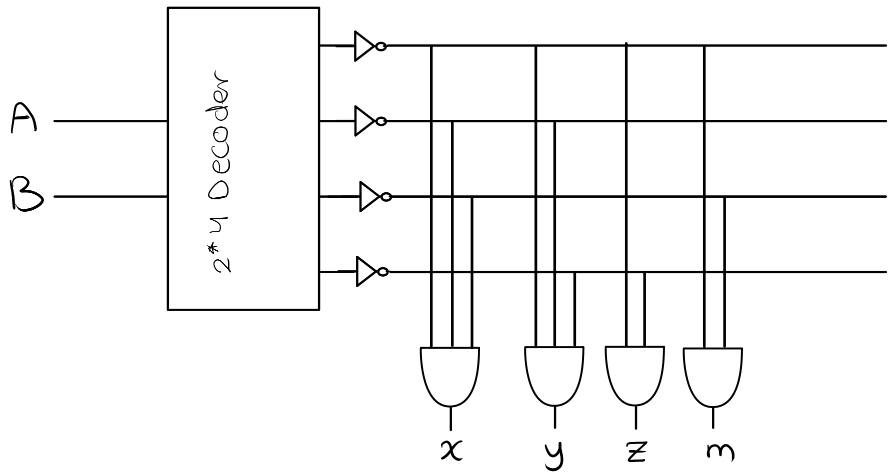


d. F(A, B, C, D)=$\prod(2,4,5,6,10,13,14)$.

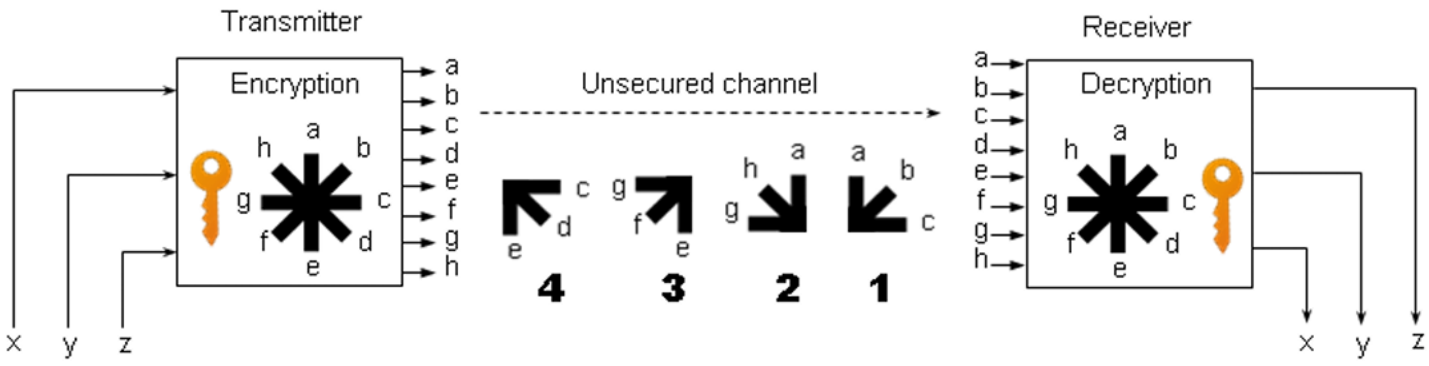


e. A logic circuit that accepts three bit number, then multiply it by 2.

A	B	x	y	z	m
0	0	0	0	0	0
0	1	0	0	1	1
1	0	0	1	1	0
1	1	1	0	0	1



21. Dear student, your friend has invented a new encryption technique which he called "Graphical Encryption" as shown below. The data to be encrypted is the numbers "1, 2, 3, 4". However, he needs your help in designing the logic circuits needed at the transmitter and receiver side.



$_{x}\backslash^{yz}$	00	01	11	10
0	X	1	0	1
1	0	X	X	X

$a = \bar{y}z + \bar{z}y = y \oplus z$

$_{x}\backslash^{yz}$	00	01	11	10
0	X	0	1	0
1	1	X	X	X

$e = \bar{y}\bar{z} + yz = y \odot z$

$_{x}\backslash^{yz}$	00	01	11	10
0	X	0	1	0
1	0	X	X	X

$F = yz$

x	y	z	a	b	c	d	e	f	g	h
0	0	0	X	X	X	X	X	X	X	X
0	0	1	1	1	1	0	0	0	0	0
0	1	0	1	0	0	0	0	0	1	1
0	1	1	0	0	0	0	1	1	1	0
1	0	0	0	0	1	1	1	0	0	0
1	0	1	X	X	X	X	X	X	X	X
1	1	0	X	X	X	X	X	X	X	X
1	1	1	X	X	X	X	X	X	X	X

× ✓ ✓ ✓ × × ✓ ✓

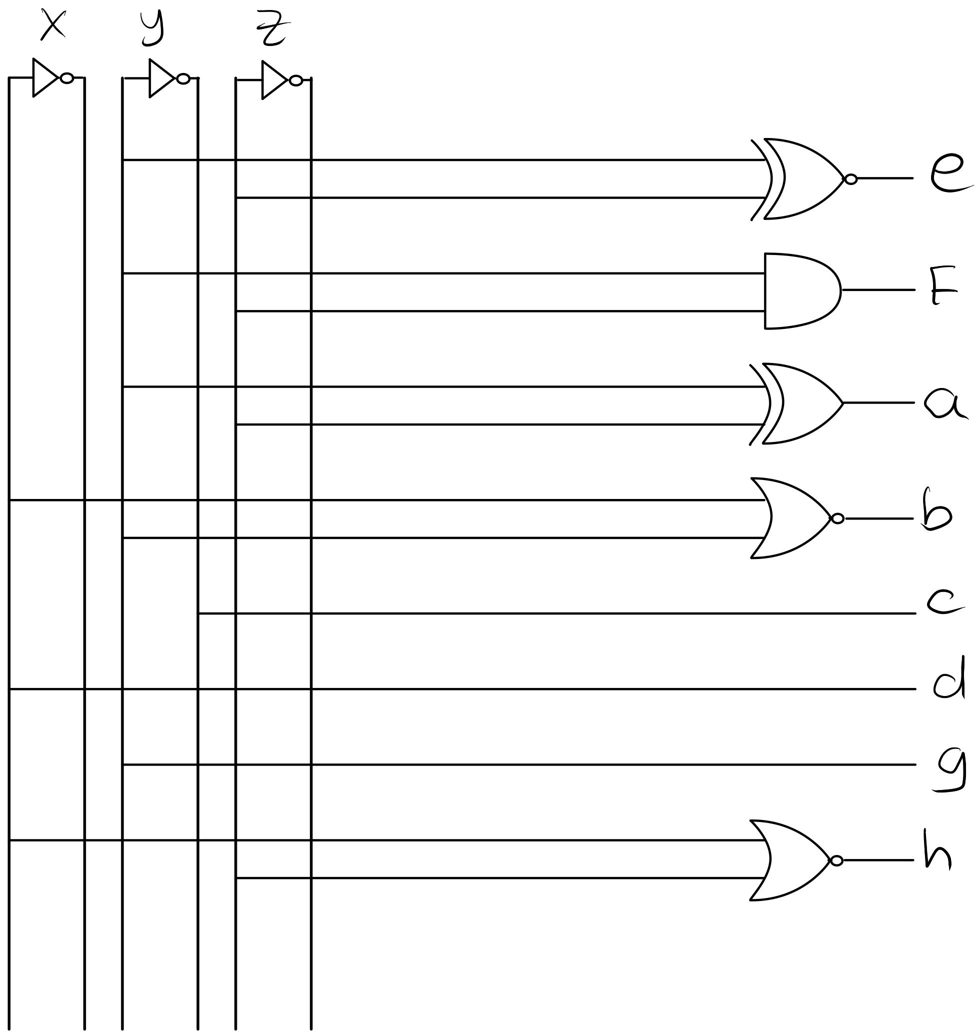
$b = (x+y)'$

$c = y'$

$d = x$

$g = y$

$h = (x+z)'$



a	b	c	d	e	f	g	h	x	y	z
1	1	1	0	0	0	0	0	0	0	1
1	0	0	0	0	0	1	1	0	1	0
0	0	0	0	1	1	1	0	0	1	1
0	0	1	1	1	0	0	0	1	0	0

علشان عدد الاحتمالات المحصول هنستخدم ال minTerms بدل ما نعمل 2^8 احتمال

$$x = \bar{a}\bar{b}c\,de\bar{f}\,\overline{g}\overline{h}$$

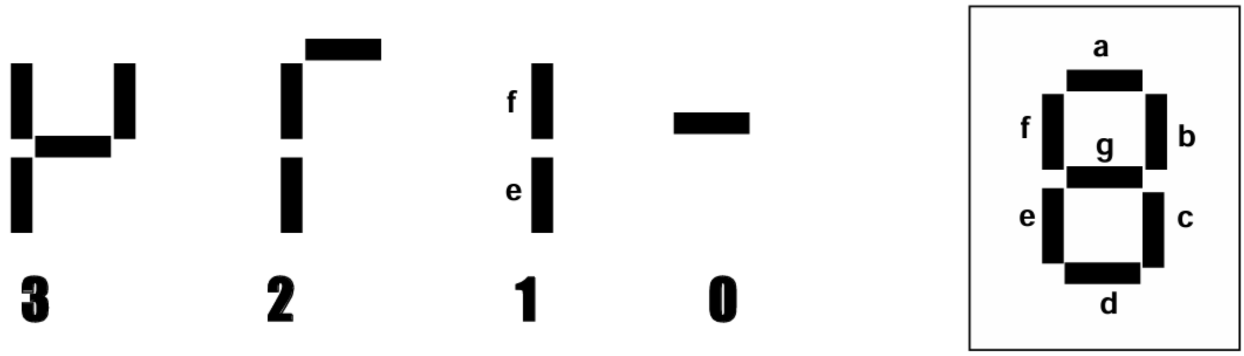
$$y = a\bar{b}\bar{c}\,\bar{d}\bar{e}\bar{f}\,gh + \bar{a}\bar{b}\bar{c}\,\bar{d}ef\,g\bar{h}$$

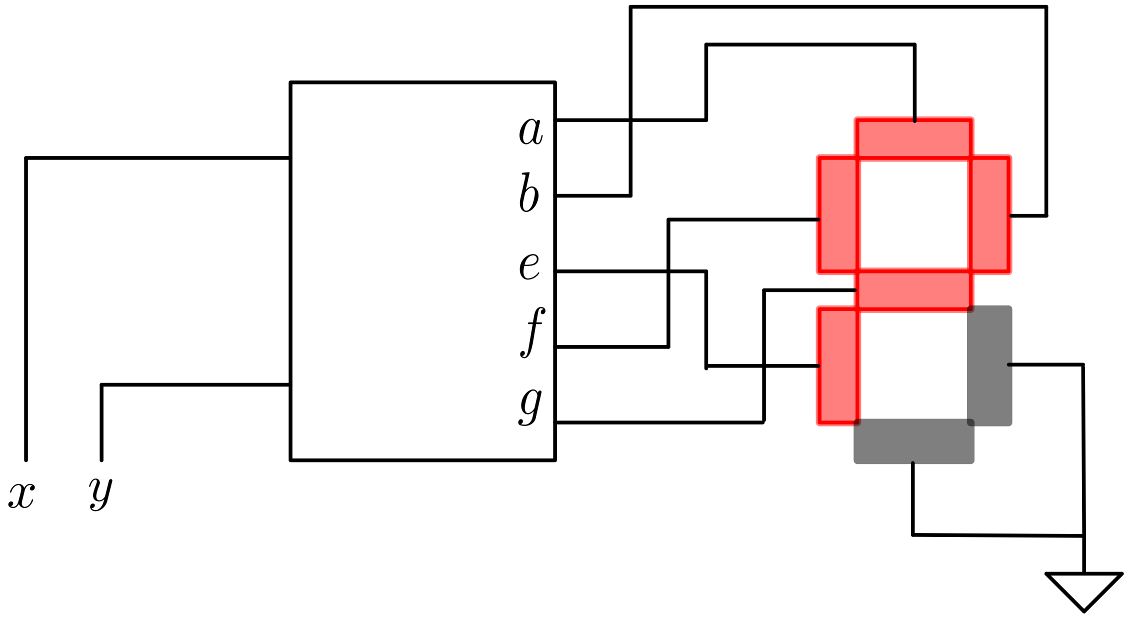
$$z = abc\,\bar{d}\bar{e}\bar{f}\,\bar{g}\bar{h} + \bar{a}\bar{b}\bar{c}\,\bar{d}ef\,g\bar{h}$$

1
السؤال قبل الأخير
نفس الفكرة والرسمة
أبسط شوية

متنساش ترسم بقا
زوغان أنا ☹

20. Design a digital circuit that accepts 2-bit binary number and the output is the numbers (0, 1, 2, 3) appeared on the seven segments in the Arabic fashion as shown in the following figure. (Note: the only used of the seven segments are the segments (a, b, e, f, g).





Truth table:

x	y	a	b	c	d	e	f	g
0	0	0	0	0	0	0	0	1
0	1	0	0	0	0	1	1	0
1	0	1	0	0	0	1	1	0
1	1	0	1	0	0	1	1	1

$\emptyset$

$x \backslash y$	0	1
0	1	0
1	0	1

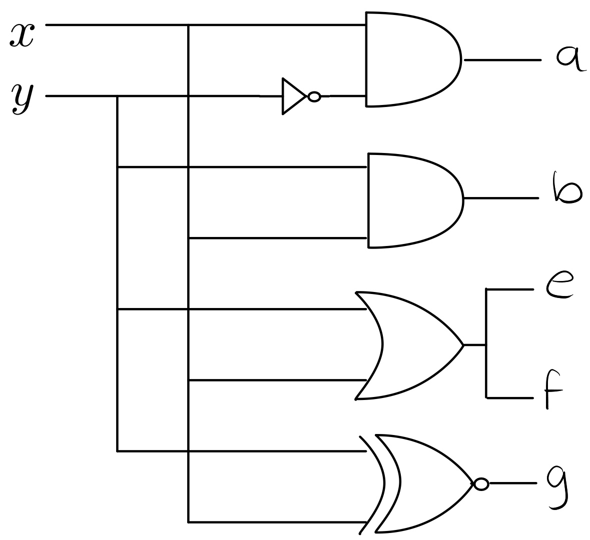
$a = x\bar{y}$

$b = xy$

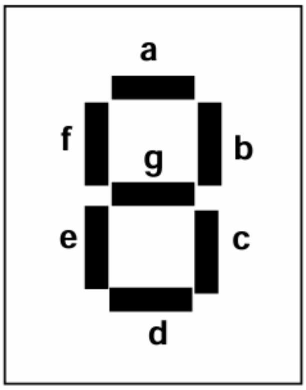
$e = x + y = f$

$g = x \odot y$

Diagram

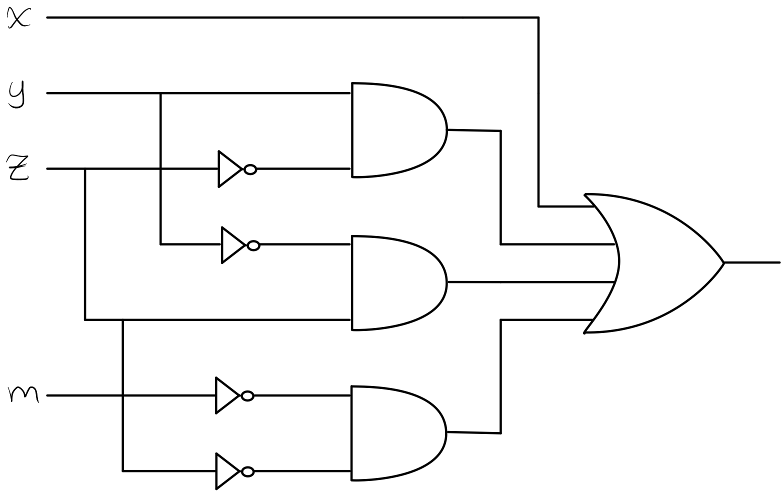


22. Design a digital circuit for segment 'g' ONLY of the circuit that accepts BCD number and the output is appeared on the seven segments display.



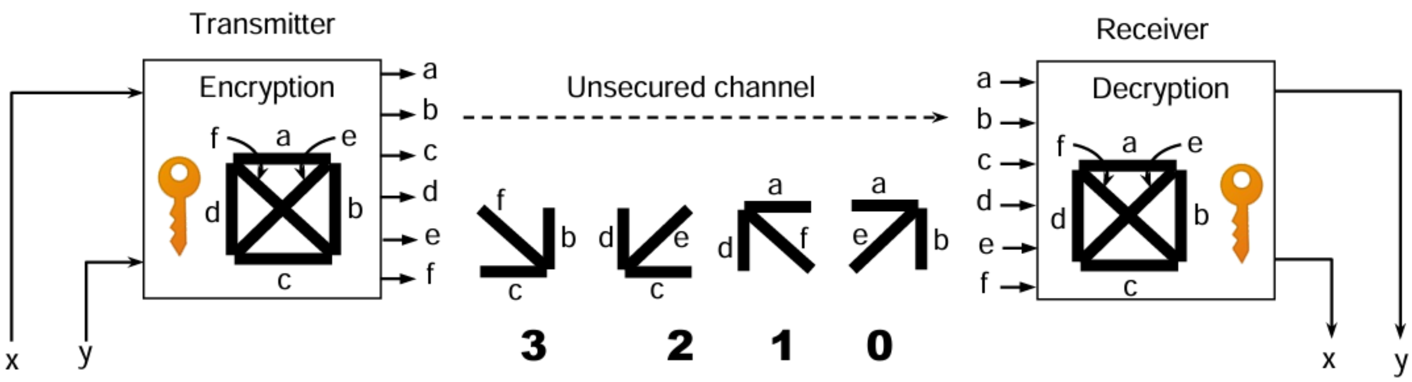
xy \ zm	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	X	X	X	X
10	1	1	X	X

$$g = x + y\bar{z} + z\bar{m} + \bar{y}z$$



x	y	z	m	g
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	X
1	0	1	1	X
1	1	0	0	X
1	1	0	1	X
1	1	1	0	X
1	1	1	1	X

23. Dear student, your friend has invented a new encryption technique which he called "Graphical Encryption" as shown below. The data to be encrypted is a two bit number. However, he needs your help in designing the logic circuits needed at the transmitter and receiver side.



x	y	a	b	c	d	e	f
0	0	1	1	0	0	1	0
0	1	1	0	0	1	0	1
1	0	0	0	1	1	1	0
1	1	0	1	1	0	0	1

$a = \bar{x}$

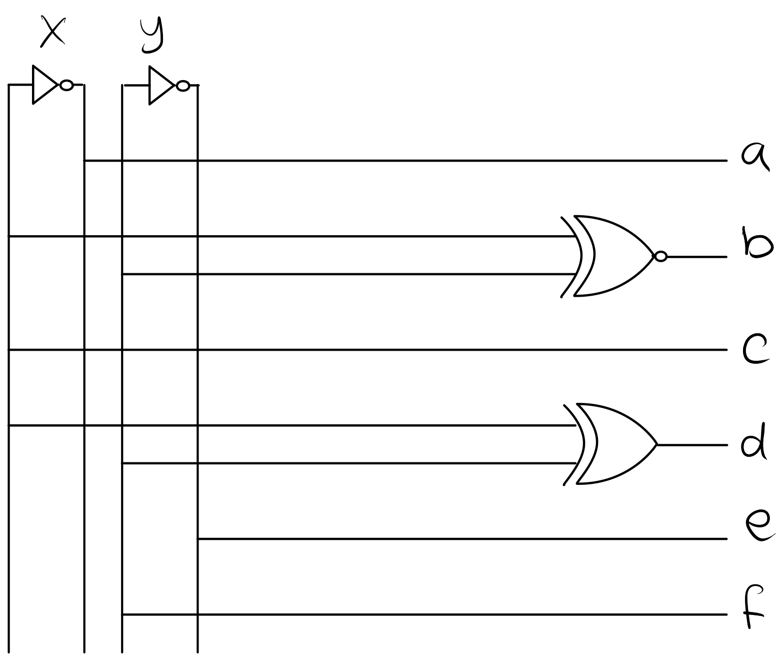
$b = x \odot y$

$c = x$

$d = x \oplus y$

$e = \bar{y}$

$f = y$

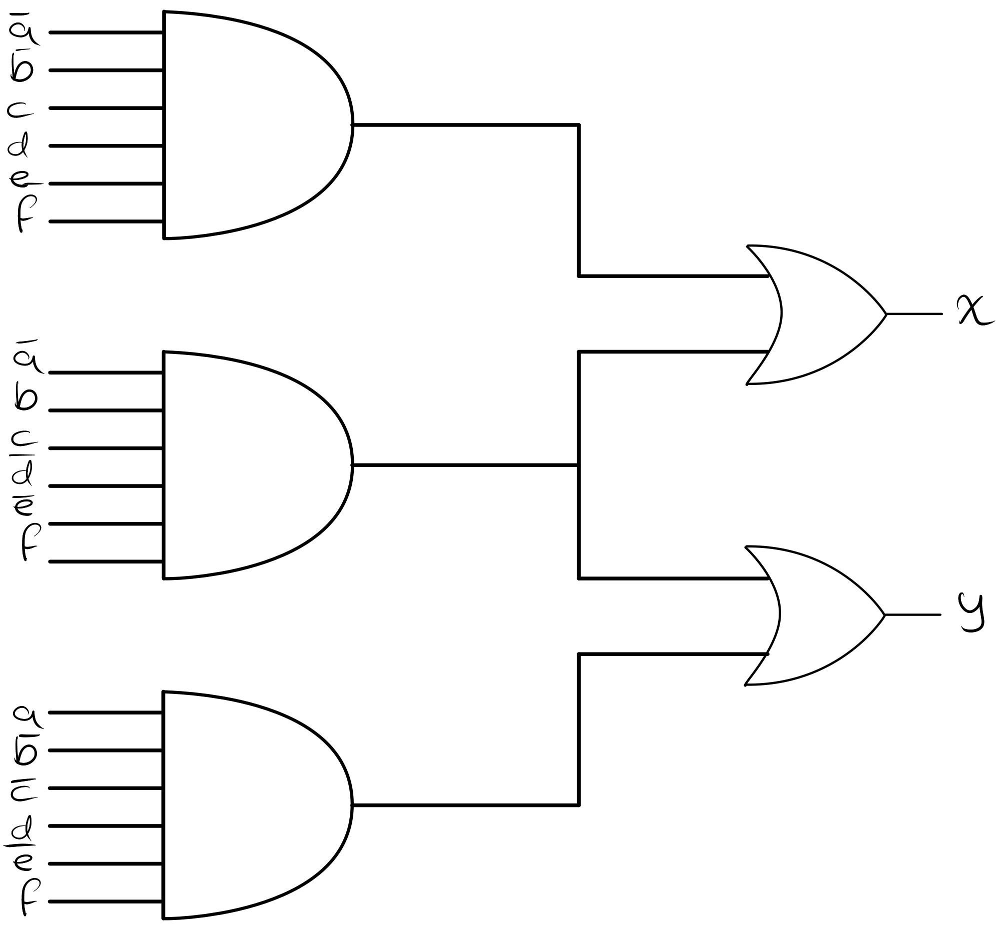


a	b	c	d	e	f	x	y
1	1	0	0	1	0	0	0
1	0	0	1	0	1	0	1
0	0	1	1	1	0	1	0
0	1	1	0	0	1	1	1

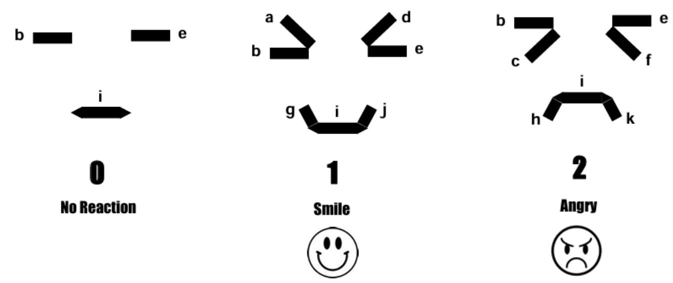
هنجيب قيم x,y بإستخدام ال min terms

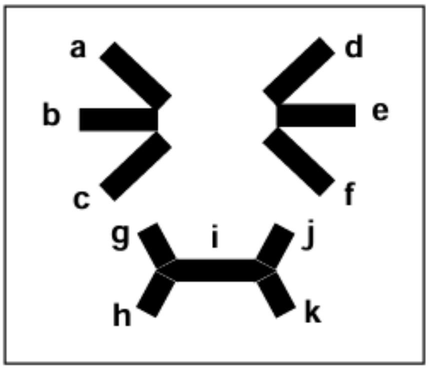
$$x = \bar{a}\bar{b}cde\bar{f} + \bar{a}bc\bar{d}\bar{e}f$$

$$y = a\bar{b}\bar{c}d\bar{e}f + \bar{a}bc\bar{d}\bar{e}f$$



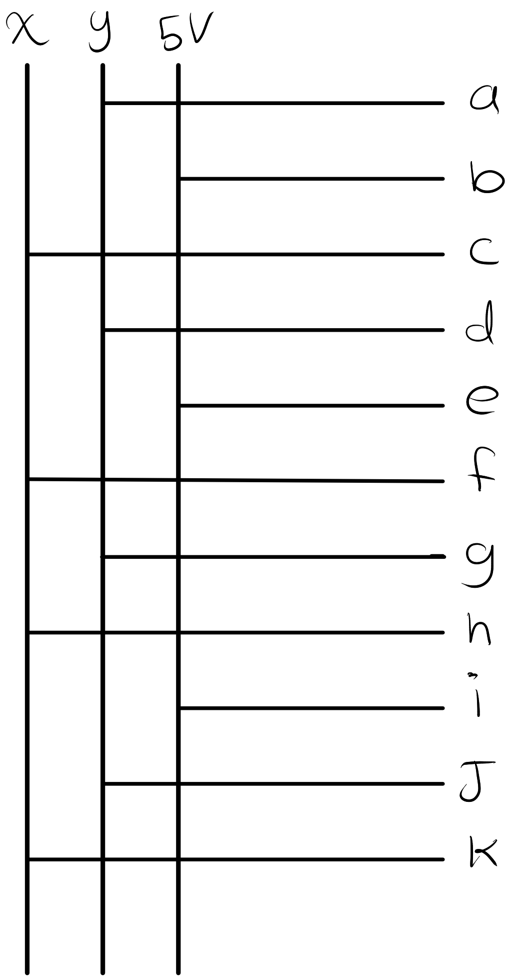
24. Design a digital circuit that accepts 2-bit binary number (0, 1, and 2 only) and the output is one of the following impressions (No Reaction, Smile, or Angry) appeared on the nine segments in the shown figures.





x	y	a	b	c	d	e	f	g	h	i	J	K
0	0	0	1	0	0	1	0	0	0	1	0	0
0	1	1	1	0	1	1	0	1	0	1	1	0
1	0	0	1	1	0	1	1	0	1	1	0	1
1	1	X	X	X	X	X	X	X	X	X	X	X

a: y, b: 1, c: x, d: y, e: 1, f: x, g: y, h: x, i: 1, J: y, K: x



و هكذا نكون قد وصلنا للختام
سائلين المولى لنا و إياكم التوفيق