Universidade de Brasília

Circuitos Digitais – Prof. Marcelo Grandi Mandelli

Lista de Exercícios 6 – Multiplexadores, Demultiplexadores, Codificadores e Decodificadores

1. Obtenha as funções booleanas para as saídas do codificador com tabela-verdade apresentada abaixo.

E7	E6	E5	E4	E3	E2	E1	E0	F2	F1	F0
0	0	0	0	0	0	0	**1**	**1**	**0**	**0**
0	0	0	0	0	0	**1**	0	**1**	**1**	**1**
0	0	0	0	0	**1**	0	0	**1**	**1**	**0**
0	0	0	0	**1**	0	0	0	**0**	**0**	**0**
0	0	0	**1**	0	0	0	0	**1**	**0**	**1**
0	0	**1**	0	0	0	0	0	**0**	**0**	**1**
0	**1**	0	0	0	0	0	0	**0**	**1**	**1**
1	0	0	0	0	0	0	0	**0**	**1**	**0**

2. Projete o circuito das funções booleanas abaixo utilizando um decodificador 3:8 e algumas portas lógicas adicionais.

   a) $F(A,B,C) = \sum m(0,4,6,7)$

   b) $F(A,B,C) = \sum m(1,2,3,5,6)$

   c) $F(A,B,C) = \sum m(0,3,7) + \sum d(1,2)$

   d) $F(A,B,C) = \overline{A}\,\overline{B}C + A\,\overline{B}C + AC$

   e) $F(A,B,C) = \overline{A} + \overline{A}B\overline{C} + A\,\overline{B}C + ABC$

3. Projete o circuito das funções booleanas abaixo utilizando um decodificador 2:4, um multiplexador 2:1 e algumas portas adicionais. Utilize B e C como entradas do decodificador e A na entrada de seleção do multiplexador.

   a) $F(A,B,C) = \sum m(0,1,3,5,7)$

   b) $F(A,B,C) = \sum m(2,3,4,6)$

c) $F(A,B,C) = \sum m(0,3,7) + \sum d(1,2)$

d) $F(A,B,C) = \overline{A}\,\overline{B} + A\,\overline{B}\,\overline{C} + C$

e) $F(A,B,C) = \overline{A} + \overline{A}B\overline{C} + A\,\overline{B} + BC$

4. Projete o circuito das funções booleanas abaixo utilizando um decodificador 2:4, um multiplexador 4:1 e algumas portas adicionais. Utilize C e D como entradas do decodificador; e A e B nas entradas de seleção do multiplexador.

a) $F(A,B,C,D) = \sum m(0,2,3,4,7,8,12,13)$

b) $F(A,B,C,D) = \sum m(2,3,6,11,13)$

c) $F(A,B,C,D) = \sum m(2,4,5,6,7,10,12)$

d) $F(A,B,C,D) = \sum m(0,3,7,9,11) + \sum d(1,2,15)$

e) $F(A,B,C,D) = A\,\overline{B}CD + A\,\overline{B}\,\overline{C}D + \overline{A}\,BC\overline{D} + \overline{A}\,BCD + \overline{A}\,\overline{B}C + AB$

f) $F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}\,C\,\overline{D} + \overline{A}\,BD + A\overline{B}C\overline{D} + ABCD$

5. Projete o circuito das funções booleanas abaixo utilizando um decodificador 3:8, um multiplexador 2:1 e algumas portas adicionais. Utilize B, C e D como entradas do decodificador; e A na entrada de seleção do multiplexador.

a) $F(A,B,C,D) = \sum m(3,6,7,8,10,12)$

b) $F(A,B,C,D) = \sum m(0,5,11,13,14)$

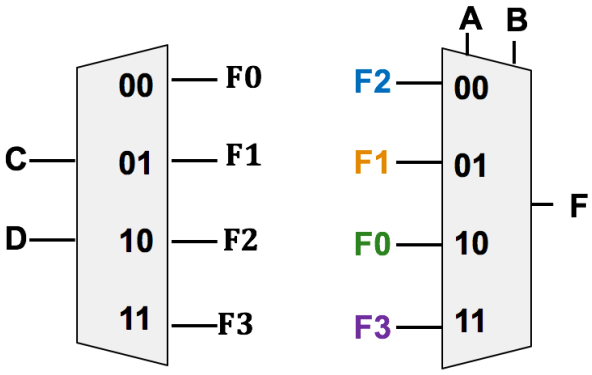
c) $F(A,B,C,D) = \sum m(0,4,8,9,11) + \sum d(1,7,13)$

d) $F(A,B,C,D) = A\,\overline{B}D + \overline{B}\,\overline{C} + \overline{A}C\overline{D} + \overline{A}\,BCD + \overline{A}\,\overline{B}CD$

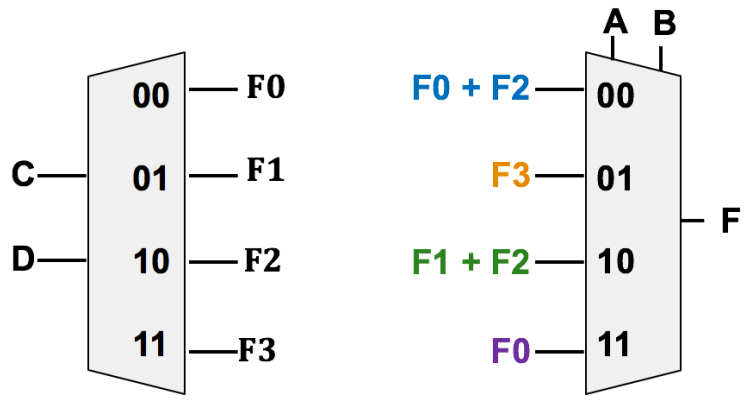
e) $F(A,B,C,D) = \overline{B}\,\overline{C}D + \overline{A}\,\overline{D} + \overline{A}\,BD + A\overline{B}C\overline{D} + ABCD$

6. Diga qual é a função booleana implementada por cada item abaixo.

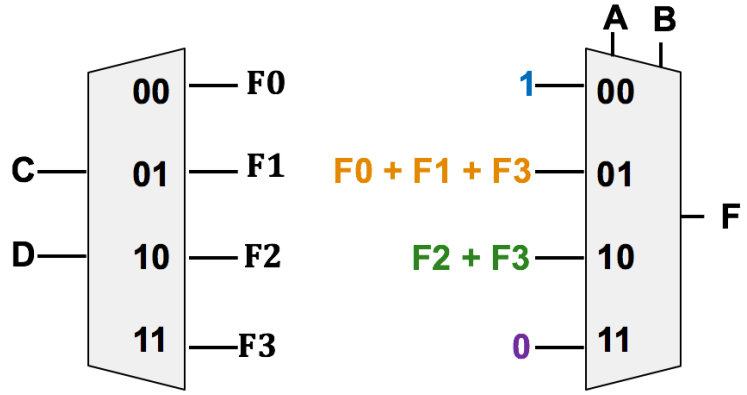
a)



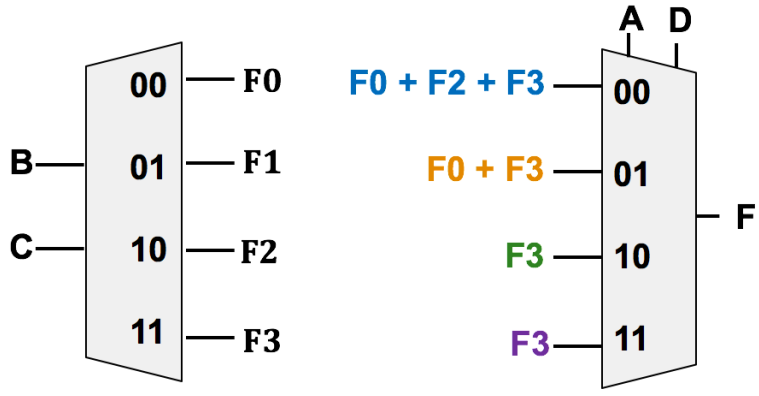
b)


00
01
10
11
F0
F1
F2
F3
C
D
A
B
F0 + F2
F3
F1 + F2
F0
F

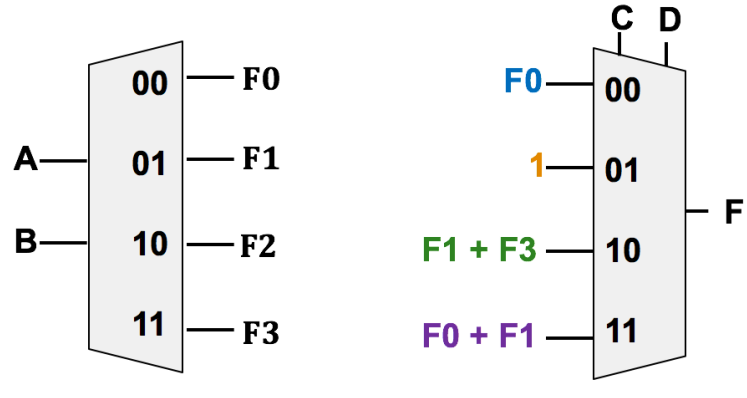
c)


00
01
10
11
F0
F1
F2
F3
C
D
A
B
1
F0 + F1 + F3
F2 + F3
0
F

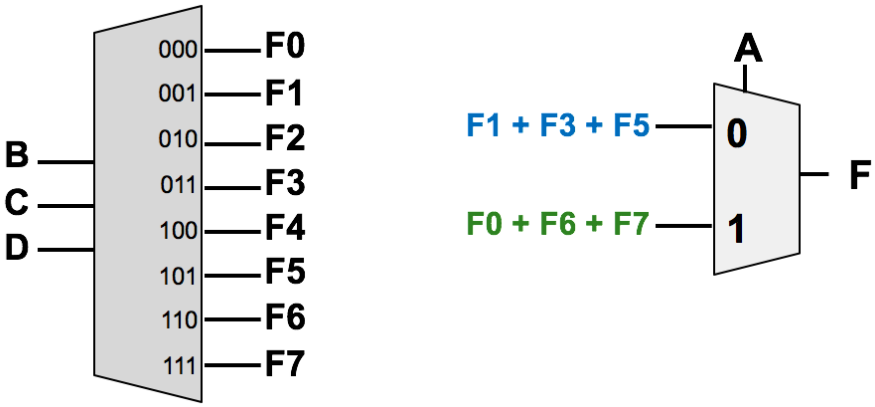
d)


00
01
10
11
F0
F1
F2
F3
B
C
A
D
F0 + F2 + F3
F0 + F3
F3
F3
F

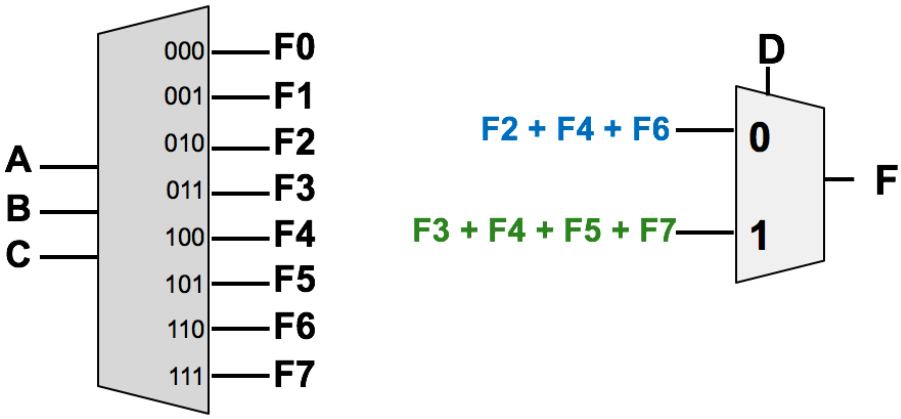
e)


00
01
10
11
F0
F1
F2
F3
A
B
C
D
F0
1
F1 + F3
F0 + F1
F

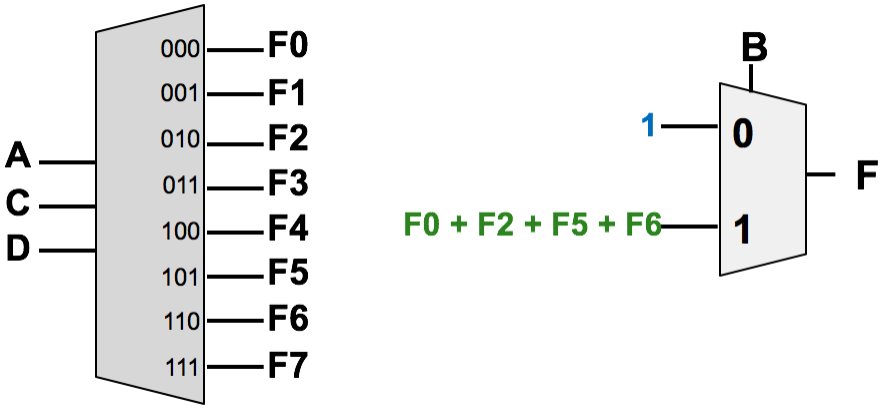
f)


000
001
010
011
100
101
110
111
F0
F1
F2
F3
F4
F5
F6
F7
B
C
D
A
F1 + F3 + F5
F0 + F6 + F7
0
1
F

g)


000
001
010
011
100
101
110
111
F0
F1
F2
F3
F4
F5
F6
F7
A
B
C
D
F2 + F4 + F6
F3 + F4 + F5 + F7
0
1
F

h)


000
001
010
011
100
101
110
111
F0
F1
F2
F3
F4
F5
F6
F7
A
C
D
B
1
F0 + F2 + F5 + F6
0
1
F

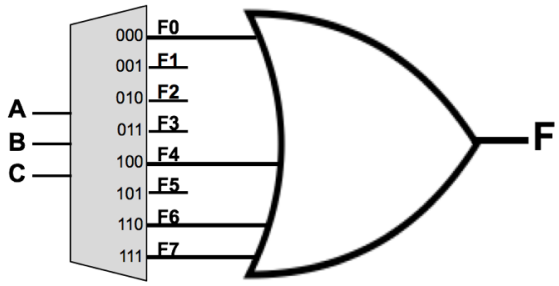
GABARITO

1.

$$\boldsymbol{F2 = E0 + E1 + E2 + E4}$$
$$\boldsymbol{F1 = E1 + E2 + E6 + E7}$$
$$\boldsymbol{F0 = E1 + E4 + E5 + E6}$$

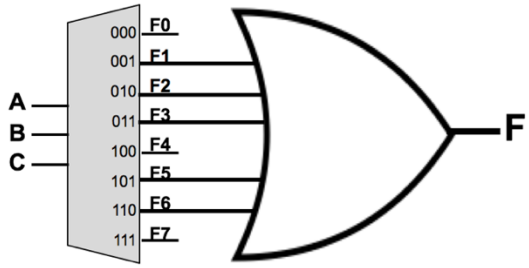
2.

a) $F(A,B,C) = \sum m(0,4,6,7)$



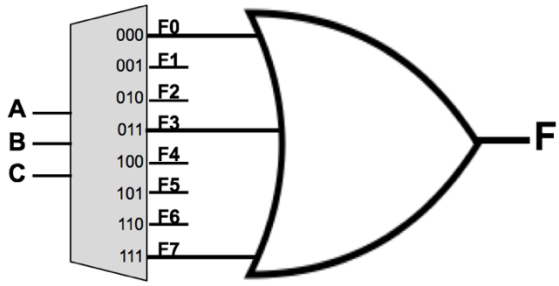
$$\boldsymbol{F(A,B,C) = F0 + F4 + F6 + F7}$$

b) $F(A,B,C) = \sum m(1,2,3,5,6)$



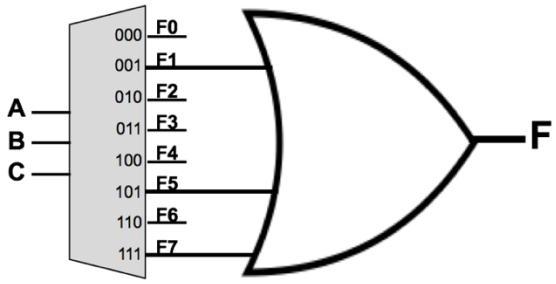
$$\boldsymbol{F(A,B,C) = F1 + F2 + F3 + F5 + F6}$$

c) $F(A,B,C) = \sum m(0,3,7) + \sum d(1,2)$



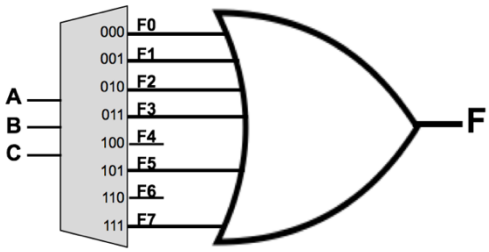
$$\boldsymbol{F(A,B,C) = F0 + F3 + F7}$$

d) $F(A,B,C) = \overline{A}\,\overline{B}C + A\,\overline{B}C + AC$



$$F(A,B,C) = F1 + F5 + F7$$

e) $F(A,B,C) = \overline{A} + \overline{A}B\overline{C} + A\,\overline{B}C + ABC$

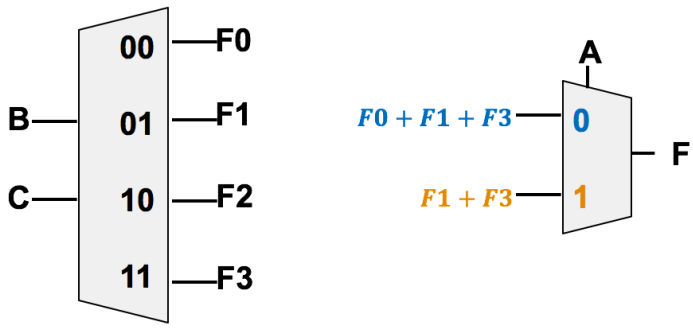


$$F(A,B,C) = F0 + F1 + F2 + F3 + F5 + F7$$

3.

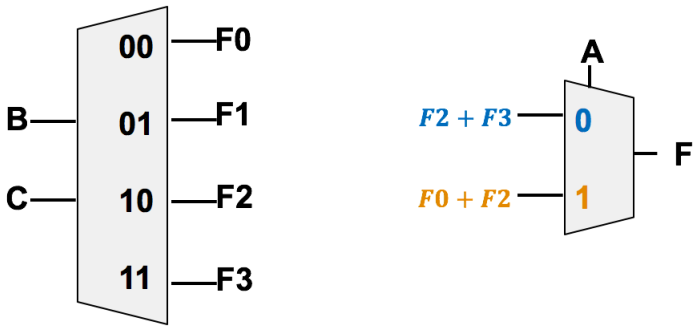
a) $F(A,B,C) = \sum m(0,1,3,5,7)$

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



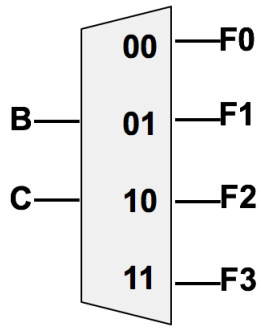
b) $F(A,B,C) = \sum m(2,3,4,6)$

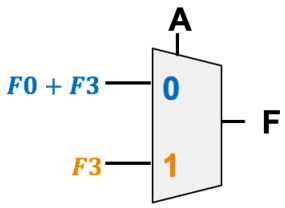
A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0



c) $F(A,B,C) = \sum m(0,3,7) + \sum d(1,2)$

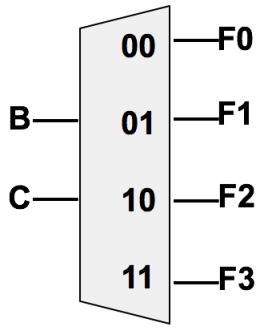
A	B	C	F
0	0	0	1
0	0	1	X
0	1	0	X
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

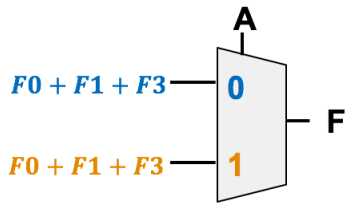




d) $F(A,B,C) = \overline{A}\,\overline{B} + A\,\overline{B}\,\overline{C} + C$

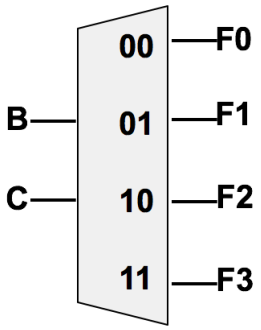
A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

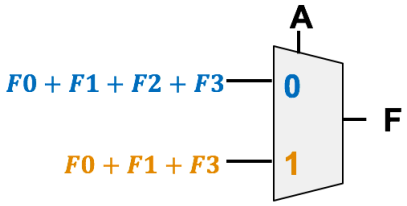




e) $F(A,B,C) = \overline{A} + \overline{A}B\overline{C} + A\,\overline{B} + BC$

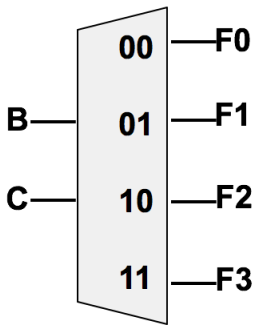
A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

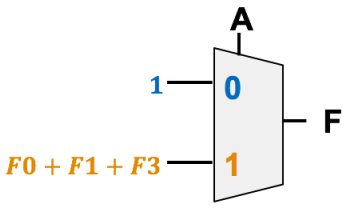




OU

A	B	C	F
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	0
1	1	1	1

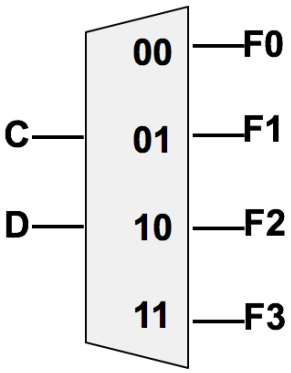


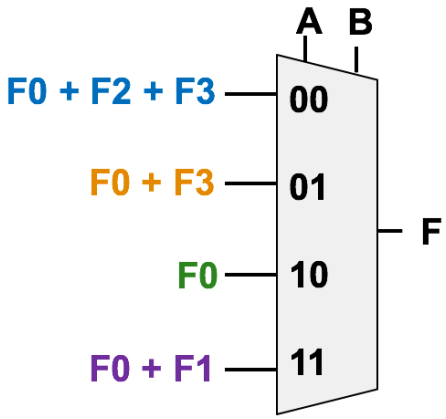


4.

a) $F(A,B,C,D) = \sum m(0,2,3,4,7,8,12,13)$

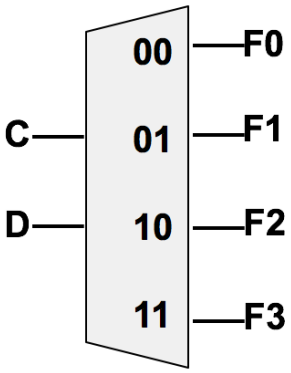
A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

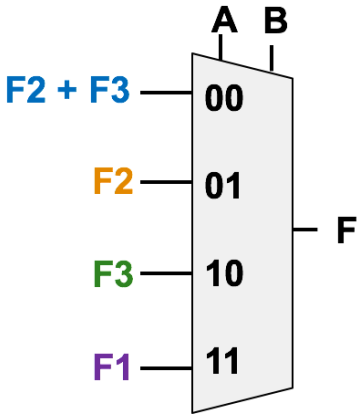




b) $F(A,B,C,D) = \sum m(2,3,6,11,13)$

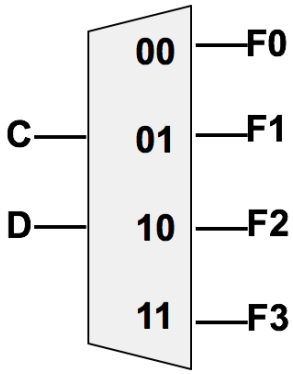
A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

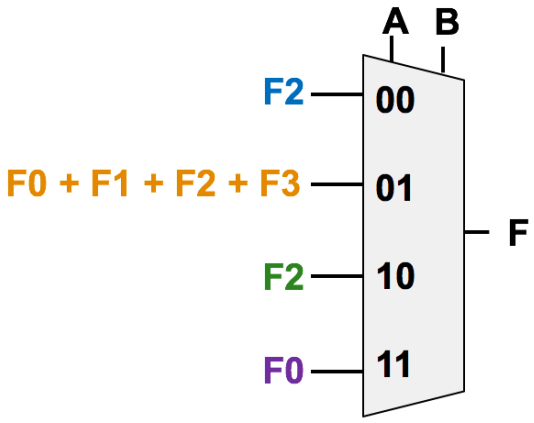




c) $F(A,B,C,D) = \sum m(2,4,5,6,7,10,12)$

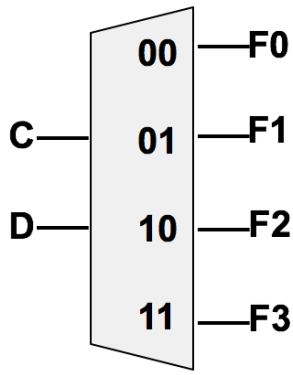
A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

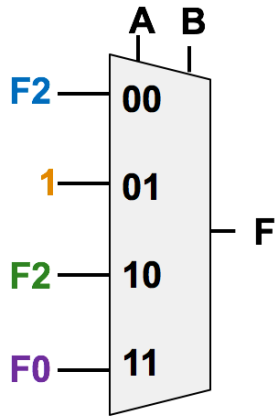




OU

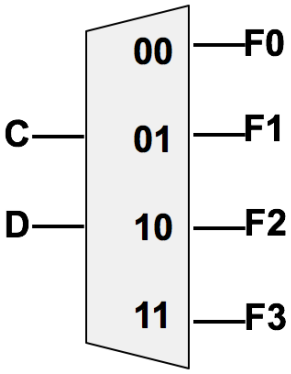
A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

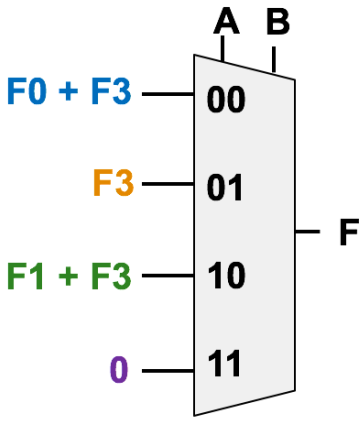




d) $F(A,B,C,D) = \sum m(0,3,7,9,11) + \sum d(1,2,15)$

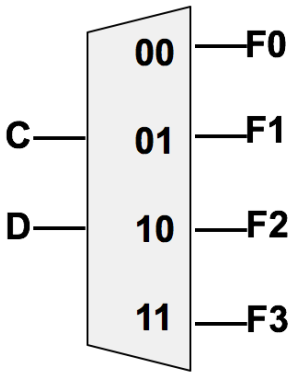
A	B	C	D	F
0	0	0	0	1
0	0	0	1	X
0	0	1	0	X
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	X

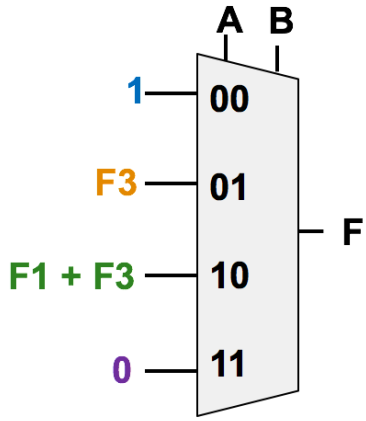




OU

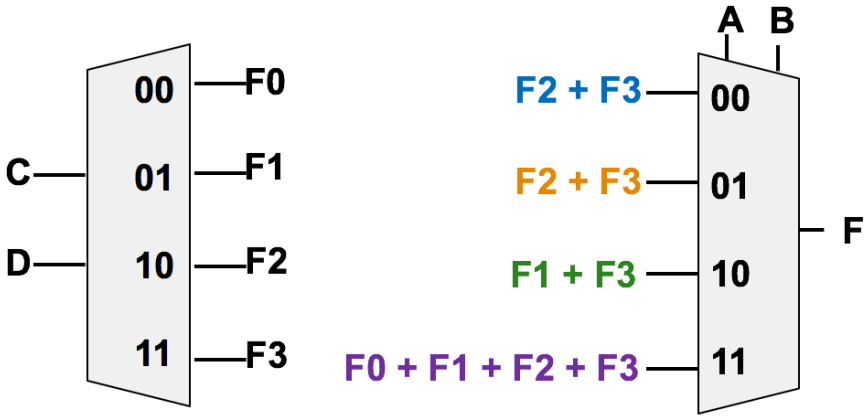
A	B	C	D	F
0	0	0	0	1
0	0	0	1	X
0	0	1	0	X
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	X





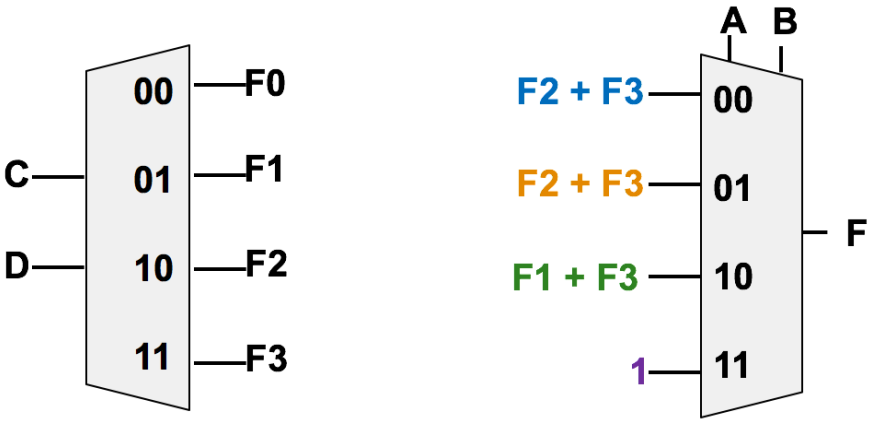
e) $F(A,B,C,D) = A\,\overline{B}CD + A\,\overline{B}\,\overline{C}D + \overline{A}\,BC\overline{D} + \overline{A}\,BCD + \overline{A}\,\overline{B}C + AB$

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1



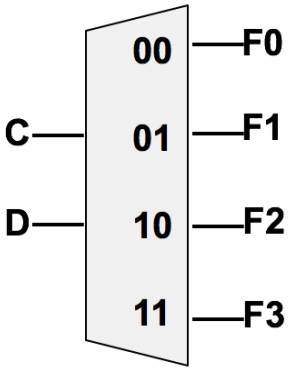
OU

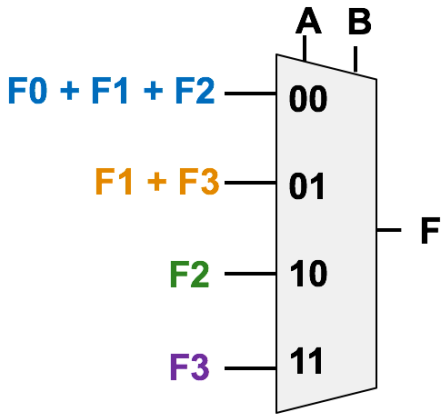
A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1



f) $F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{B}\,C\,\overline{D} + \overline{A}\,BD + A\overline{B}C\overline{D} + ABCD$

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

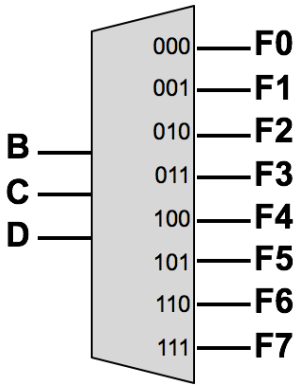


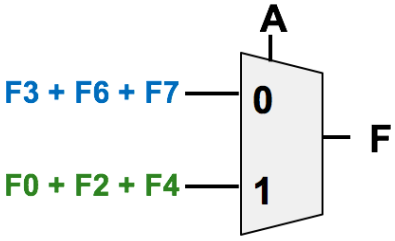


5.

a) $F(A,B,C,D) = \sum m(3,6,7,8,10,12)$

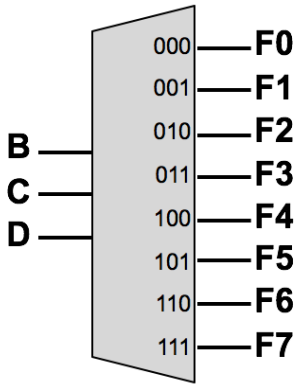
A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

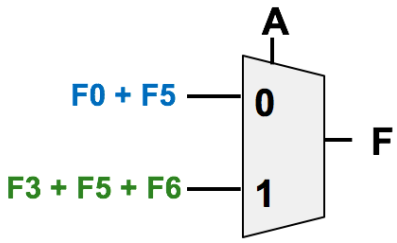




b) $F(A,B,C,D) = \sum m(0,5,11,13,14)$

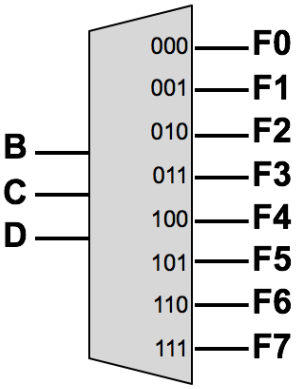
A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

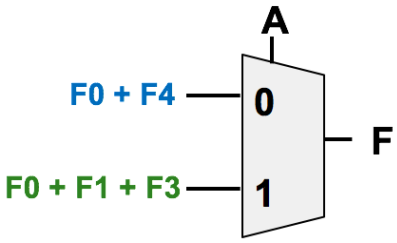




c) $F(A,B,C,D) = \sum m(0,4,8,9,11) + \sum d(1,7,13)$

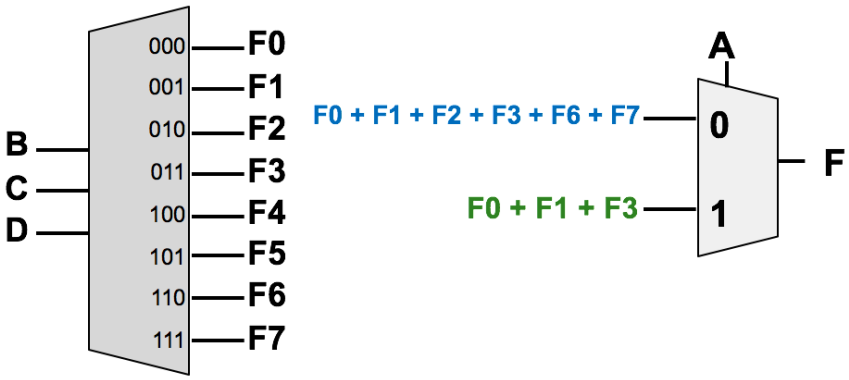
A	B	C	D	F
0	0	0	0	1
0	0	0	1	X
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	X
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	X
1	1	1	0	0
1	1	1	1	0





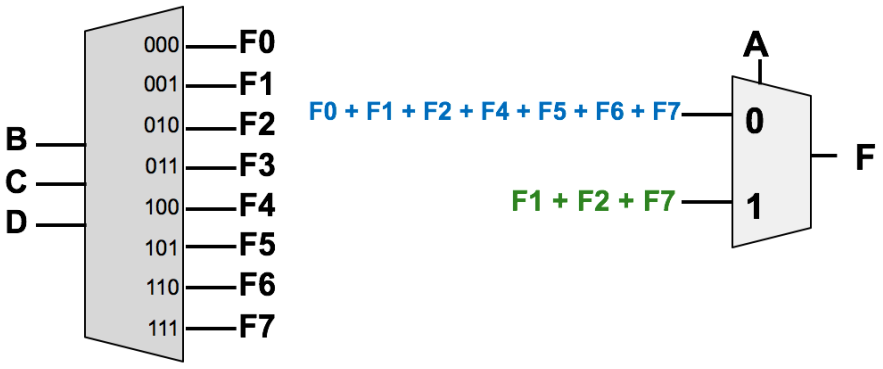
d) $F(A,B,C,D) = A\,\overline{B}D + \overline{B}\,\overline{C} + \overline{A}C\overline{D} + \overline{A}\,BCD + \overline{A}\,\overline{B}CD$

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0



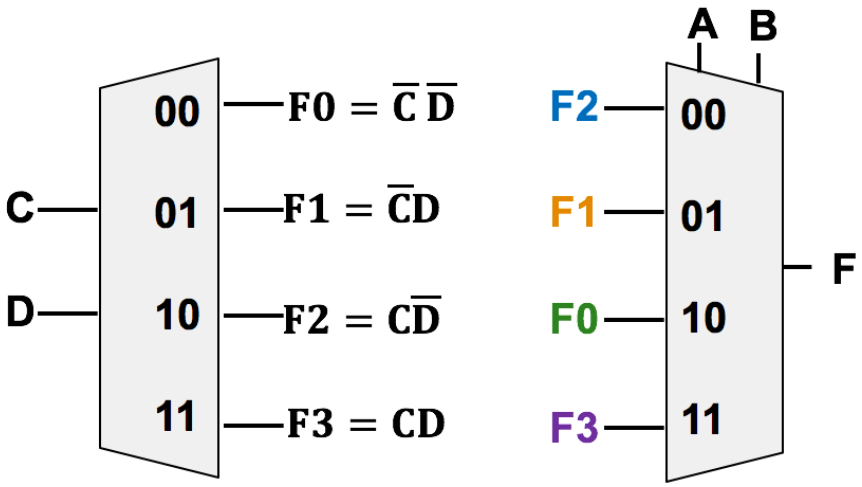
e) $F(A,B,C,D) = \overline{B}\,\overline{C}D + \overline{A}\,\overline{D} + \overline{A}\,BD + A\overline{B}C\overline{D} + ABCD$

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1



6.

a)

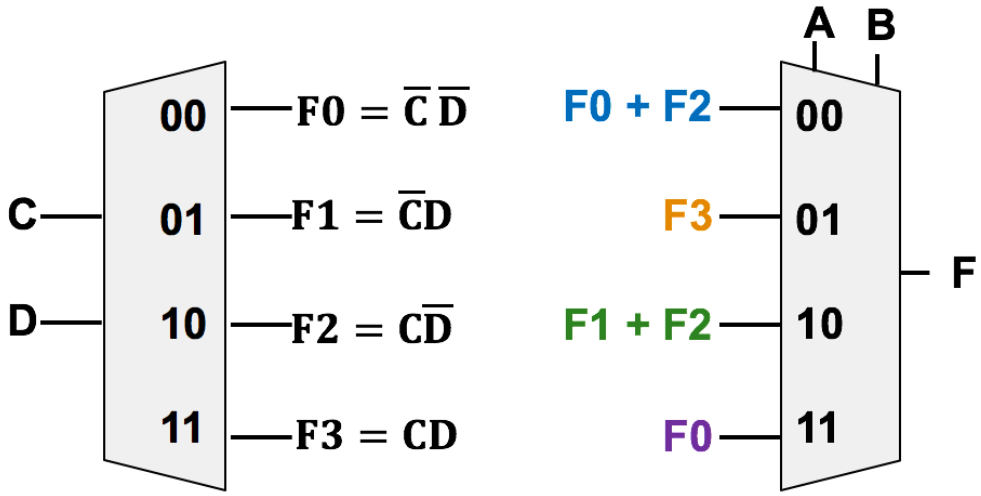


$$F(A,B,C,D) = \bar{A}\,\bar{B}(F2) + \bar{A}B(F1) + A\bar{B}(F0) + AB(F3)$$

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

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

b)

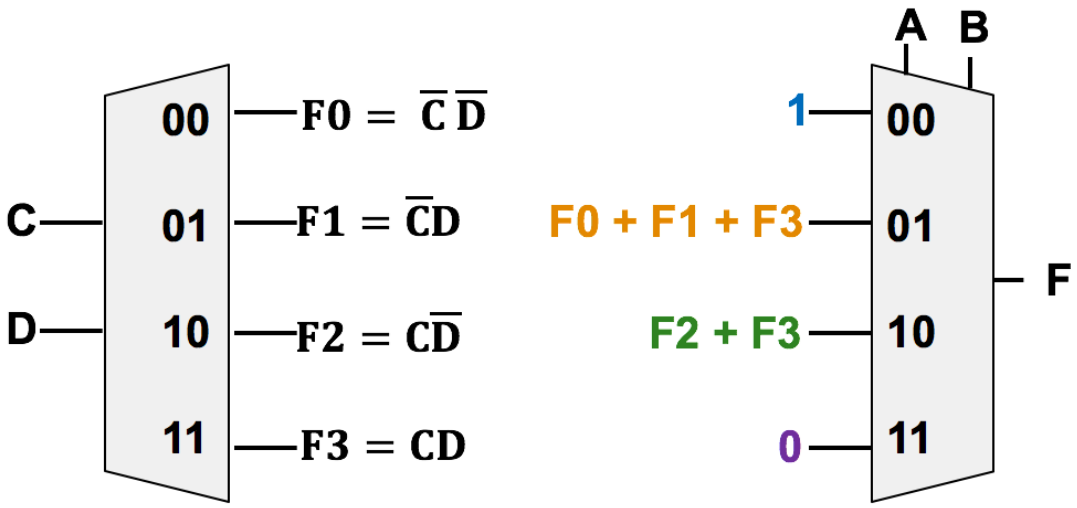


$$F(A,B,C,D) = \bar{A}\,\bar{B}(F0 + F2) + \bar{A}B(F3) + A\bar{B}(F1 + F2) + AB(F0)$$

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

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

c)

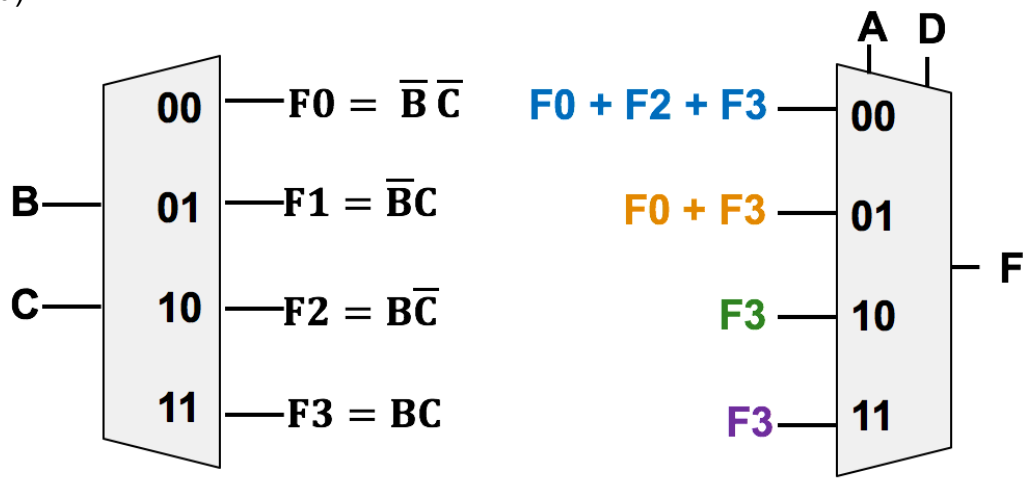


$$F(A,B,C,D) = \overline{A}\,\overline{B}(1) + \overline{A}B(F0 + F1 + F3) + A\overline{B}(F2 + F3) + AB(0)$$

$$F(A,B,C,D) = \overline{A}\,\overline{B} + \overline{A}B\left(\overline{C}\,\overline{D} + \overline{C}D + CD\right) + A\overline{B}\left(C\overline{D} + CD\right)$$

$$F(A,B,C,D) = \overline{A}\,\overline{B} + \overline{A}B\overline{C}\,\overline{D} + \overline{A}B\overline{C}D + \overline{A}BCD + A\overline{B}C\overline{D} + A\overline{B}CD$$

d)



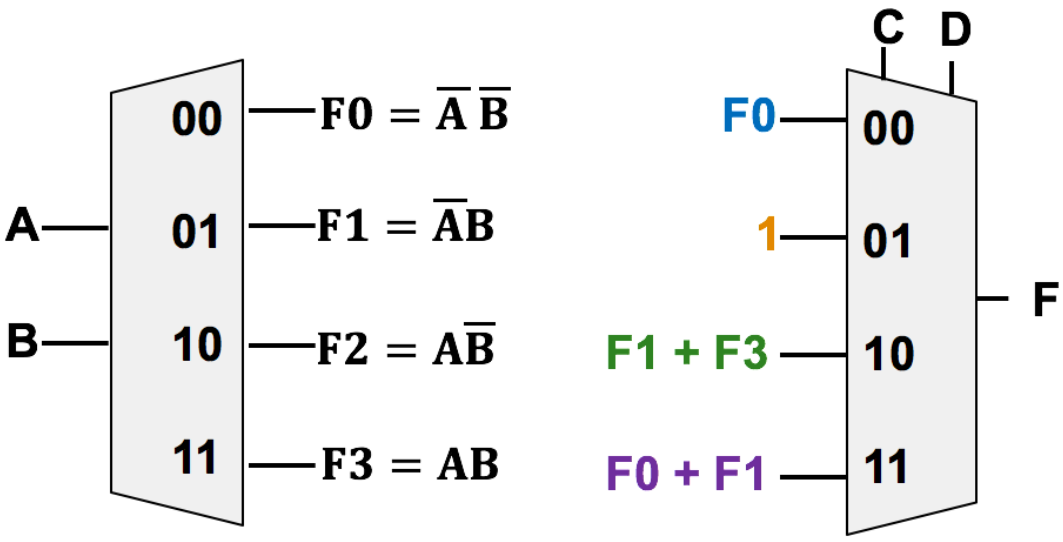
$$F(A,B,C,D) = \overline{A}\,\overline{D}(F0 + F2 + F3) + \overline{A}D(F0 + F3) + A\overline{D}(F3) + AD(F3)$$

$$F(A,B,C,D) = \overline{A}\,\overline{D}\left(\overline{B}\,\overline{C} + B\overline{C} + BC\right) + \overline{A}D\left(\overline{B}\,\overline{C} + BC\right) + A\overline{D}(BC) + AD(BC)$$

$$F(A,B,C,D) = \overline{A}\,\overline{D}\,\overline{B}\,\overline{C} + \overline{A}\,\overline{D}B\overline{C} + \overline{A}\,\overline{D}BC + \overline{A}D\overline{B}\,\overline{C} + \overline{A}DBC + A\overline{D}BC + ADBC$$

$$F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{A}B\overline{C}\,\overline{D} + \overline{A}BC\overline{D} + \overline{A}\,\overline{B}\,\overline{C}D + \overline{A}BCD + ABC\overline{D} + ABCD$$

e)



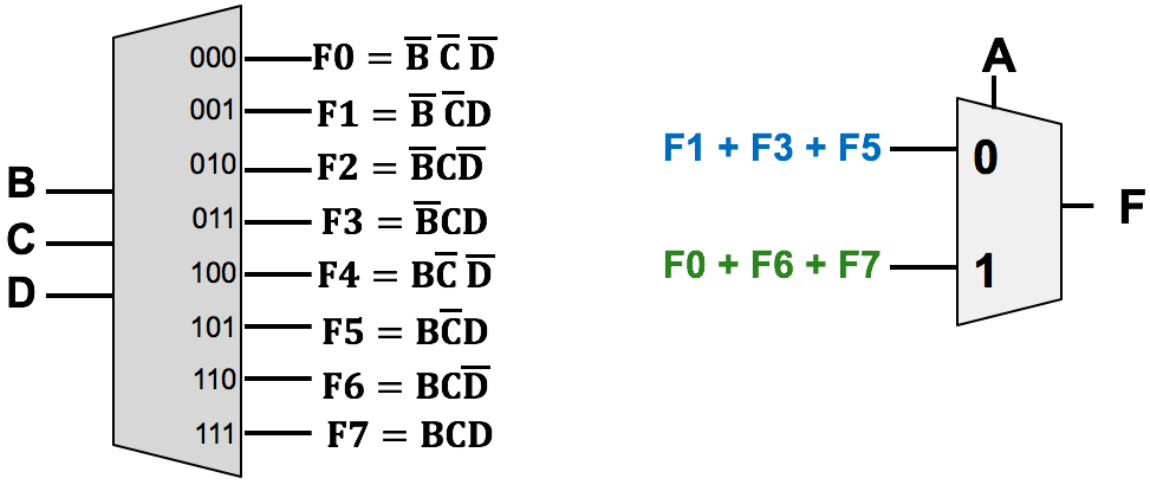
$$F(A,B,C,D) = \overline{C}\,\overline{D}(F0) + \overline{C}D(1) + C\overline{D}(F1 + F3) + CD(F0 + F1)$$

$$F(A,B,C,D) = \overline{C}\,\overline{D}(\overline{A}\,\overline{B}) + \overline{C}D(1) + C\overline{D}(\overline{A}B + A\overline{B}) + CD(\overline{A}\,\overline{B} + \overline{A}B)$$

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

$$F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C}\,\overline{D} + \overline{C}D + \overline{A}BC\overline{D} + AB\overline{C}\,\overline{D} + \overline{A}\,\overline{B}CD + \overline{A}BCD$$

f)

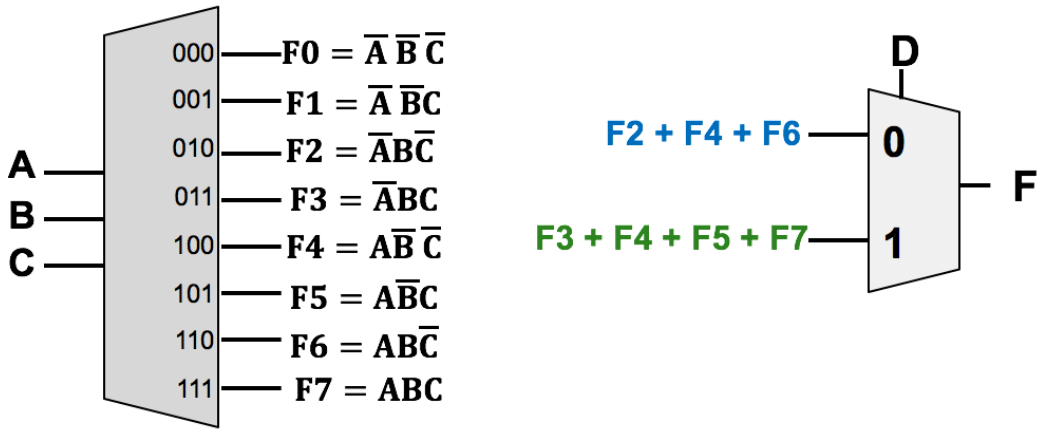


$$F(A,B,C,D) = \overline{A}(F1 + F3 + F5) + A(F0 + F6 + F7)$$

$$F(A,B,C,D) = \overline{A}(\overline{B}\,\overline{C}D + \overline{B}CD + B\overline{C}D) + A(\overline{B}\,\overline{C}\,\overline{D} + BC\overline{D} + BCD)$$

$$F(A,B,C,D) = \overline{A}\,\overline{B}\,\overline{C}D + \overline{A}\,\overline{B}CD + \overline{A}B\overline{C}D + A\overline{B}\,\overline{C}\,\overline{D} + ABC\overline{D} + ABCD$$

g)

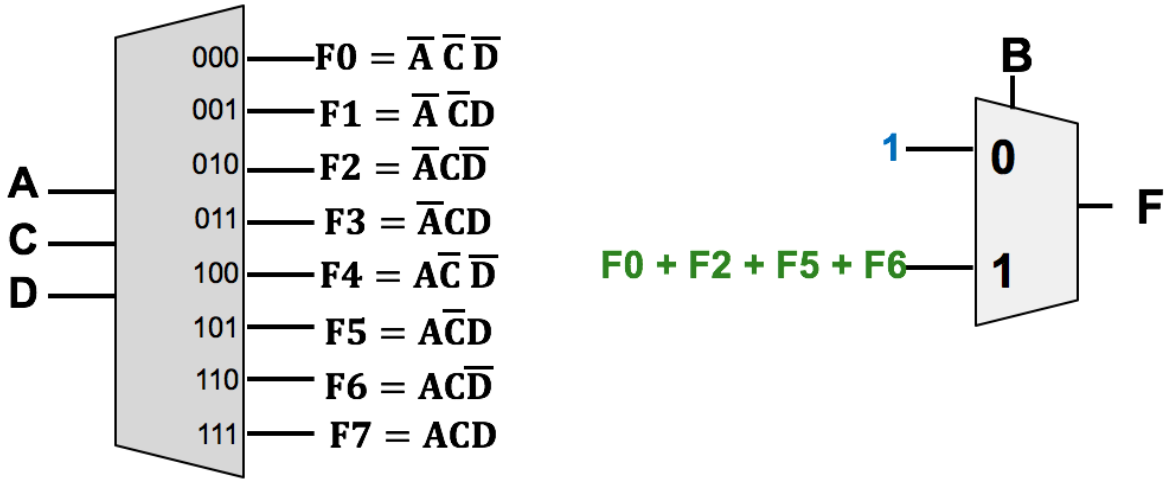


$$F(A,B,C,D) = \overline{D}(F2 + F4 + F6) + D(F3 + F4 + F5 + F7)$$

$$F(A,B,C,D) = \overline{D}\left(\overline{A}B\overline{C} + A\overline{B}\,\overline{C} + AB\overline{C}\right) + D\left(\overline{A}BC + A\overline{B}\,\overline{C} + A\overline{B}C + ABC\right)$$

$$F(A,B,C,D) = \overline{A}B\overline{C}\,\overline{D} + A\overline{B}\,\overline{C}\,\overline{D} + AB\overline{C}\,\overline{D} + \overline{A}BCD + A\overline{B}\,\overline{C}D + A\overline{B}CD + ABCD$$

h)



$$F(A,B,C,D) = \overline{B}(1) + B(F0 + F2 + F5 + F6)$$

$$F(A,B,C,D) = \overline{B} + B\left(\overline{A}\,\overline{C}\,\overline{D} + \overline{A}C\overline{D} + A\overline{C}D + AC\overline{D}\right)$$

$$F(A,B,C,D) = \overline{B} + B\overline{A}\,\overline{C}\,\overline{D} + B\overline{A}CD + BA\overline{C}D + BAC\overline{D}$$

$$F(A,B,C,D) = \overline{B} + \overline{A}B\,\overline{C}\,\overline{D} + \overline{A}BCD + AB\overline{C}D + ABC\overline{D}$$