Universidade de Brasília

Circuitos Digitais - Prof. Marcelo Grandi Mandelli

Lista de Exercícios 4 – Álgebra Booleana e Mapa de Karnaugh

1. Monte a tabela verdade para cada uma das funções booleanas abaixo:

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

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

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

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

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

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

2. Determine a função booleana correspondente para cada tabela verdade abaixo utilizando uma soma-de-produtos padrão e também um produto-de-somas padrão:

   a)

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	**0**
0	1	1	0	**0**
0	1	1	1	**0**
1	0	0	0	**0**
1	0	0	1	**1**
1	0	1	0	**0**
1	0	1	1	**0**
1	1	0	0	**0**
1	1	0	1	**1**
1	1	1	0	**1**
1	1	1	1	**0**

   b)

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

c)

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

d)

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

e)

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

3. Obtenha a função booleana simplificada (em soma-de-produtos) de cada mapa de Karnaugh abaixo:

a)

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

b)

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

c)

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

d)

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

e)

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

f)

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

g)

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

h)

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

i)

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

j)

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

k)

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

l)

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

m)

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

n)

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

4. Simplifique as seguintes funções booleanas usando mapas de karnaugh. A função booleana simplificada deve ser uma soma-de-produtos.

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

   b) $F(A,B,C) = \sum m(1,2,6,7)$

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

   d) $F(A,B,C) = \prod M(2,4,5,7)$

   e) $F(A,B,C) = \sum m(2,5) + \sum d\,(0,1,4,7)$

   f) $F(A,B,C,D) = \sum m(0,3,5,8,13,15)$

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

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

   i) $F(A,B,C,D) = \sum m(1,2,5,10,11) + \sum d\,(0,7,8,9)$

   j) $F(A,B,C,D) = \sum m(1,2,4,8,11,12,15)$

GABARITO

1.

a)

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

b)

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	**1**
1	1	1	**1**

c)

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

d)

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

e)

A	B	C	D	F
0	0	0	0	**0**
0	0	0	1	**0**
0	0	1	0	**0**
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	**1**
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)

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

2.

a)

- soma-de-produtos:

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

- produto-de-somas:

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

b)

- soma-de-produtos:

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

- produto-de-somas:

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

c)

- soma-de-produtos:

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

- produto-de-somas:

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

d)

- soma-de-produtos:

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

- produto-de-somas:

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

e)

- soma-de-produtos:

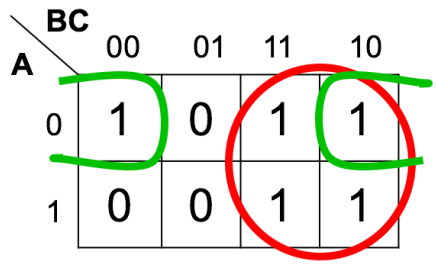
$$F(A,B,C) = \overline{A}\,B\,\overline{C} + A\,\overline{B}\,\overline{C} + A\overline{B}\,C$$

- produto-de-somas:

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

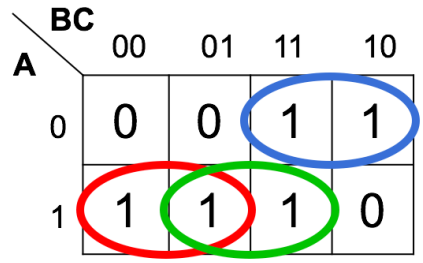
3. Pode haver diferentes respostas corretas para esse exercício!

a)



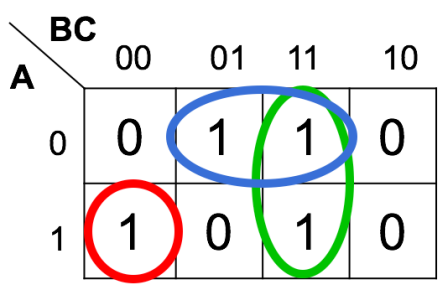
$$\boldsymbol{F(A,B,C) = B + \overline{A}\,\overline{C}}$$

b)



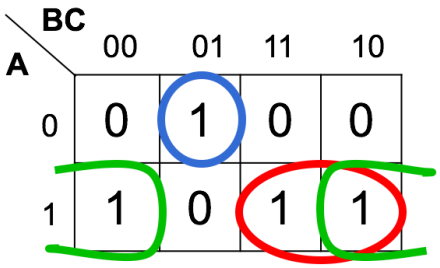
$$\boldsymbol{F(A,B,C) = A\overline{B} + AC + \overline{A}B}$$

c)



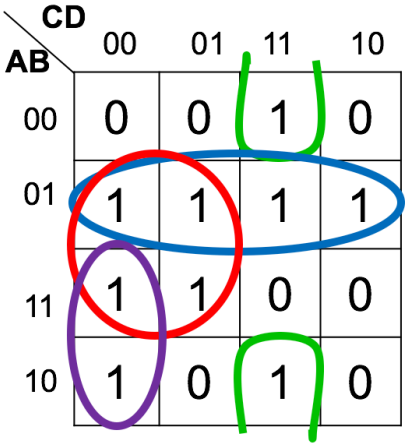
$$\boldsymbol{F(A,B,C) = A\overline{B}\,\overline{C} + BC + \overline{A}C}$$

d)



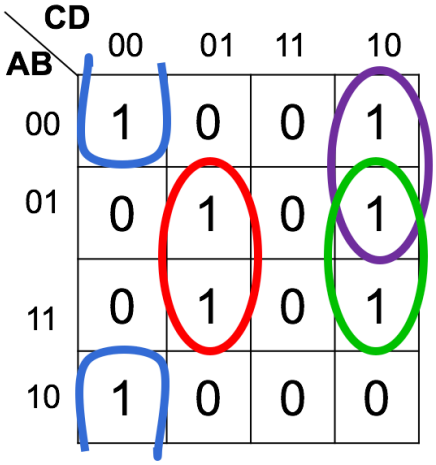
$$F(A,B,C) = AB + A\overline{C} + \overline{A}\,\overline{B}C$$

e)



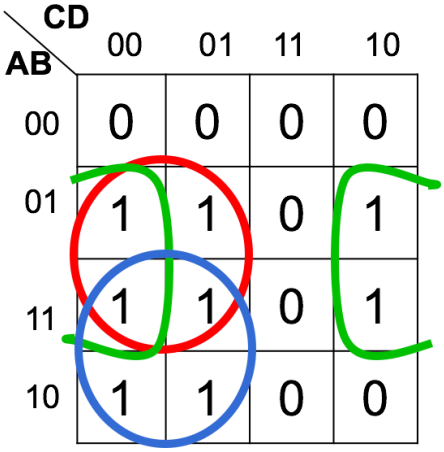
$$F(A,B,C,D) = B\overline{C} + \overline{B}CD + \overline{A}B + A\overline{C}\,\overline{D}$$

f)



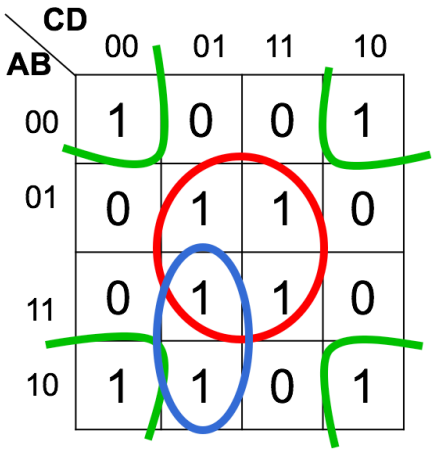
$$F(A,B,C,D) = B\overline{C}D + BC\overline{D} + \overline{B}\,\overline{C}\,\overline{D} + \overline{A}C\overline{D}$$

g)



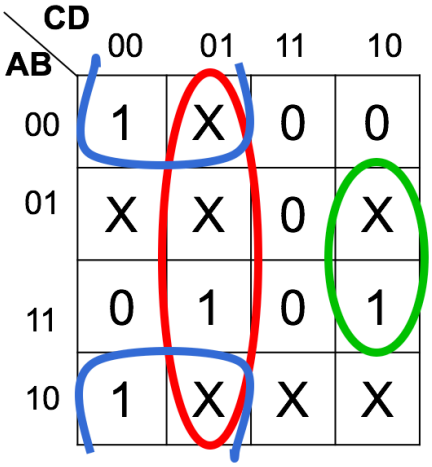
$$F(A,B,C,D) = B\overline{C} + B\overline{D} + A\overline{C}$$

h)



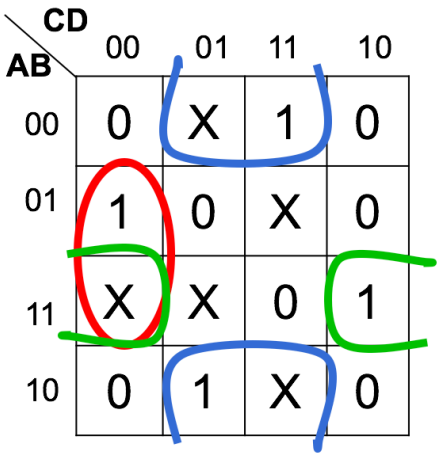
$$F(A,B,C,D) = BD + \overline{B}\,\overline{D} + A\overline{C}D$$

i)



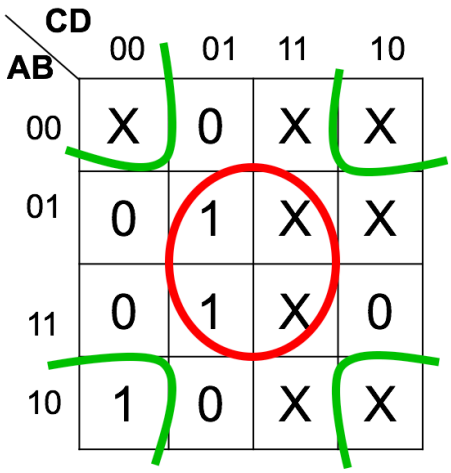
$$F(A,B,C,D) = \overline{C}D + B\overline{C}\overline{D} + \overline{B}\,\overline{C}$$

j)



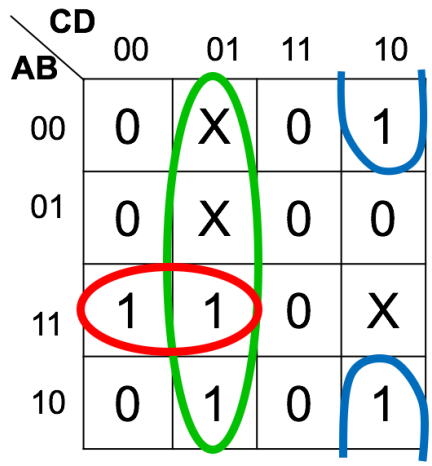
$$F(A,B,C,D) = B\overline{C}\,\overline{D} + AB\overline{D} + \overline{B}D$$

k)



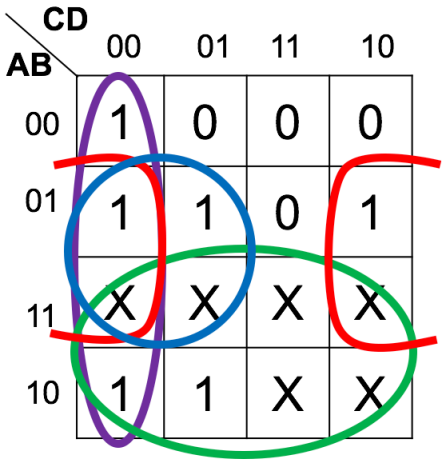
$$F(A,B,C,D) = BD + \overline{B}\,\overline{D}$$

l)



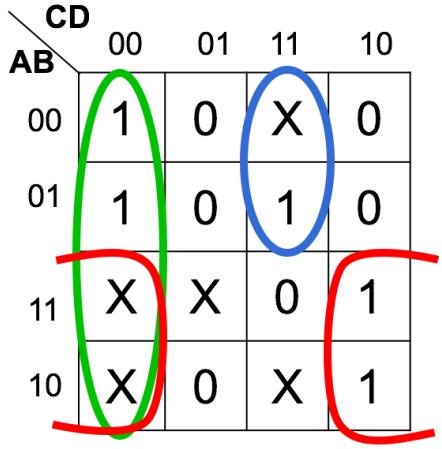
$$F(A,B,C,D) = AB\overline{C} + \overline{C}D + \overline{B}C\overline{D}$$

m)



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

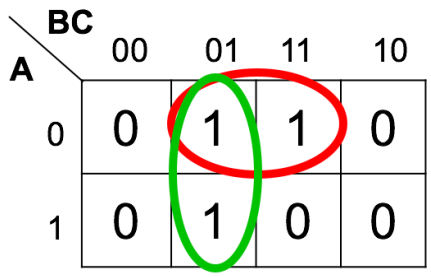
n)



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

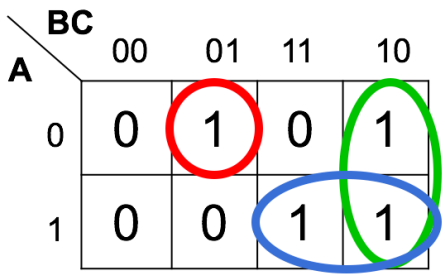
4. Pode haver diferentes respostas corretas para esse exercício!

a)



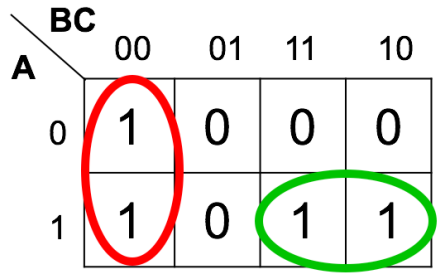
$$F(A,B,C) = \overline{A}C + \overline{B}C$$

b)



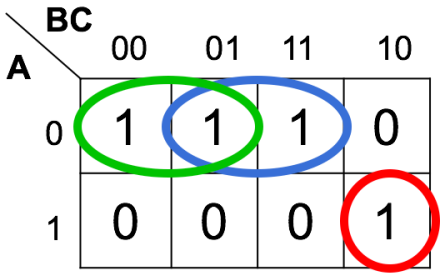
$$F(A,B,C) = \overline{A}\,\overline{B}C + B\overline{C} + AB$$

c)



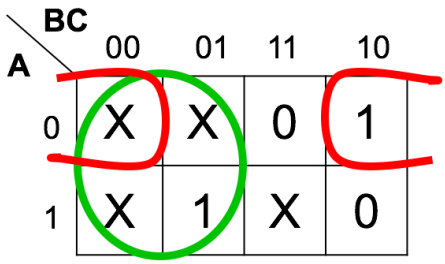
$$F(A,B,C) = \overline{B}\,\overline{C} + AB$$

d)



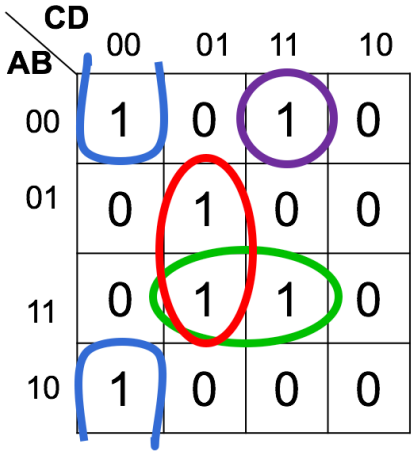
$$F(A,B,C) = AB\overline{C} + \overline{A}\,\overline{B} + \overline{A}C$$

e)



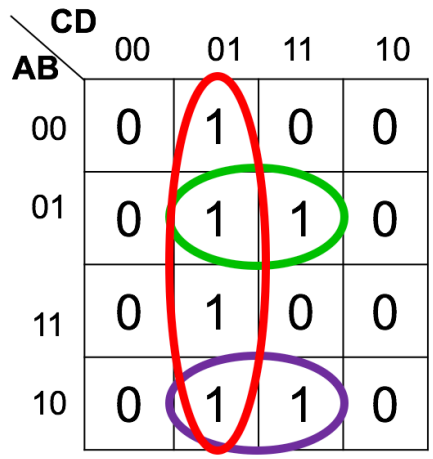
$$F(A,B,C) = \overline{A}\,\overline{C} + \overline{B}$$

f)



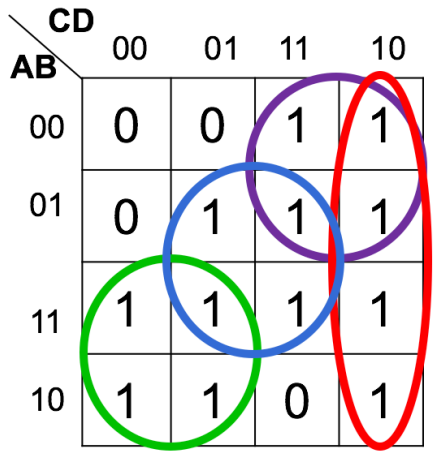
$$F(A,B,C,D) = B\overline{C}D + ABD + \overline{B}\,\overline{C}\,\overline{D} + \overline{A}\,\overline{B}CD$$

g)



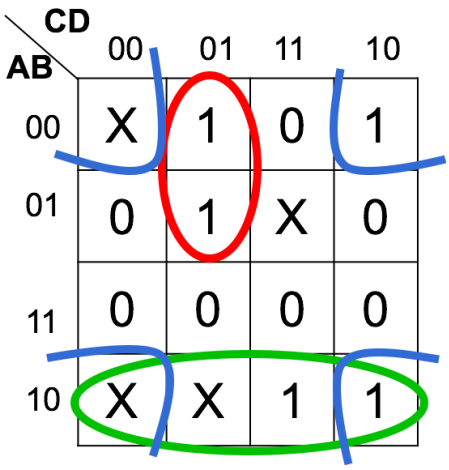
$$F(A,B,C,D) = \overline{C}D + \overline{A}BD + A\overline{B}D$$

h)



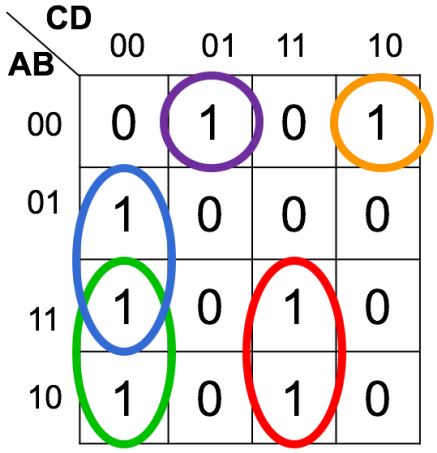
$$F(A,B,C,D) = C\overline{D} + A\overline{C} + \overline{A}C + BD$$

i)



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

j)



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