

LAB 4

Question 1.

q)

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

$$d(A, B, C) = \sum m(0, 7)$$

A \ BC				
	00	01	11	10
0	- ₀	0 ₁	1 ₃	0 ₂
1	0 ₄	1 ₅	- ₇	1 ₆

Diagram illustrating the Karnaugh map for the function $F(A, B, C)$. The map shows the function value for each combination of A, B, C . The prime implicants are identified by dashed green boxes and labeled G_1 , G_2 , and G_3 .

- G_1 (BC): A group of two cells (11, 10) in row 0.
- G_2 (AC): A group of two cells (01, 11) in column 1.
- G_3 (AB): A group of two cells (01, 11) in column 1.

$$G_1 = BC$$

$$G_2 = AC$$

$$G_3 = AB$$

Prime implicants: BC, AC, AB

Essential prime implicants: BC, AC, AB

$$\underline{F = BC + AC + AB}$$

$$b) F(W, X, Y, Z) = \sum m(0, 2, 4, 5, 8, 14, 15)$$

$$d(W, X, Y, Z) = \sum m(7, 10, 13)$$

WX \ YZ		YZ			
		00	01	11	10
00	prime	1			1
	00	0	1	3	2
01	G2	1	1	-	
	01	4	5	7	6
11			-	1	1
	11	12	13	15	14
10		1			-
	10	8	9	11	10

Annotations: Prime implicants are circled in purple. G1 is a group of 1s at (0,0) and (0,1). G2 is a group of 1s at (0,0) and (0,1). G3 is a group of 1s at (1,1) and (1,0). The 1 at (1,1) is also circled in purple and labeled 'prime'.

$$G_1 = X'Z' \quad G_2 = W'XY' \quad G_3 = WXY$$

Prime Implicants: $X'Z'$, $W'XY'$, WXY , $W'Y'Z'$, WYZ'

Essential prime imp: $X'Z'$, $W'XY'$, WXY

$$F = X'Z' + W'XY' + WXY$$

Question 2.

$$a) F(W, X, Y, Z) = \sum m(5, 6, 11, 12)$$

$$d(W, X, Y, Z) = \sum m(0, 1, 2, 9, 10, 14, 15)$$

WX \ YZ	00	01	11	10
	00	01	11	10
00	-	-	0	-
01	0	1	0	1
11	1	0	-	-
10	0	-	1	-

Karnaugh map for $d(W, X, Y, Z)$ with prime implicants G_1, G_2, G_3, G_4 highlighted by dashed green lines.

$$G_1 = WY \quad G_2 = YZ' \quad G_3 = WXZ' \quad G_4 = W'Y'Z$$

$$F = WY + YZ' + WXZ' + W'Y'Z$$

b)

WX \ YZ	00	01	11	10
	00	01	11	10
00	-	-	0	-
01	0	1	0	1
11	1	0	-	-
10	0	-	1	-

Karnaugh map for $d(W, X, Y, Z)$ with prime implicants G_1, G_2, G_3, G_4 highlighted by dashed green lines.

$$G_1 = X + Z \quad G_2 = W + Y + Z$$

$$G_3 = W + Y' + Z' \quad G_4 = W' + X' + Z'$$

$$F = (X + Z)(W + Y + Z)(W + Y' + Z')(W' + X' + Z')$$

Question 3

$$T_1 = B'C$$

$$T_2 = A'B$$

$$T_3 = A + T_1$$

$$T_4 = 0 \oplus T_2' \quad F = T_3 + T_4 \quad G = 0' + T_2$$

A	B	C	D	T ₁	T ₂	T ₃	T ₄	F	G
0	0	0	0	0	0	0	1	1	1
0	0	0	1	0	0	0	0	0	0
0	0	1	0	1	0	1	1	1	1
0	0	1	1	1	0	1	0	1	0
0	1	0	0	0	1	0	0	0	1
0	1	0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	0	0	1
0	1	1	1	0	1	0	1	1	1
1	0	0	0	0	0	1	1	1	1
1	0	0	1	0	0	1	0	1	0
1	0	1	0	1	0	1	1	1	1
1	0	1	1	1	0	1	0	1	0
1	1	0	0	0	0	1	1	1	1
1	1	0	1	0	0	1	0	1	0
1	1	1	0	0	0	1	1	1	1
1	1	1	1	0	0	1	0	1	0
1	1	1	0	0	0	1	1	1	1
1	1	1	1	0	0	1	0	1	0

Question 4

k-map for F

$$F = \sum m(0, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15)$$

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

Diagram showing groupings for G1, G2, G3, and G4. G1 is a 2x4 group (rows 11, 10). G2 is a 4x2 group (columns 01, 11). G3 is a 2x2 group (rows 00, 01; columns 11, 10). G4 is a 2x2 group (rows 00, 01; columns 00, 01).

$$G1 = A \quad G2 = B'D' \quad G3 = CD \quad G4 = BD$$

$$\underline{F = A + B'D' + CD + BD}$$

k-map for G

$$G = \sum m(0, 2, 4, 5, 6, 7, 8, 10, 12, 14)$$

AB \ CD	00	01	11	10	
00	1 ₀			1 ₂	→ G1
01	1 ₁	1 ₅	1 ₇	1 ₆	
11	1 ₁₂			1 ₁₄	→ G2
10	1 ₈			1 ₁₀	

$$G_1 = D'$$

$$G_2 = A'B$$

$$\underline{G = D' + A'B}$$

Question 5

$$F = T_3 + T_4$$

$$\underbrace{4 + 4 + 1}$$

9 literals

$$G = D' + T_2$$

$$\underbrace{1 + 2 + 1}$$

4 literals

$$A + B'D' + CD + BD$$

$$\underbrace{\hspace{10em}}$$

8 literals

$$\underbrace{D' + A'B}$$

4 literals.

for G

Ans: for F it is simpler, it is same

Question 6

a)

A	B	C	D	F
0	0	0	0	1
0	0	1	1	1
0	1	0	2	1
0	1	1	3	0
1	0	0	4	0
1	0	1	5	0
1	1	0	6	0
1	1	1	7	0

$$F = \sum m(0, 1, 2)$$

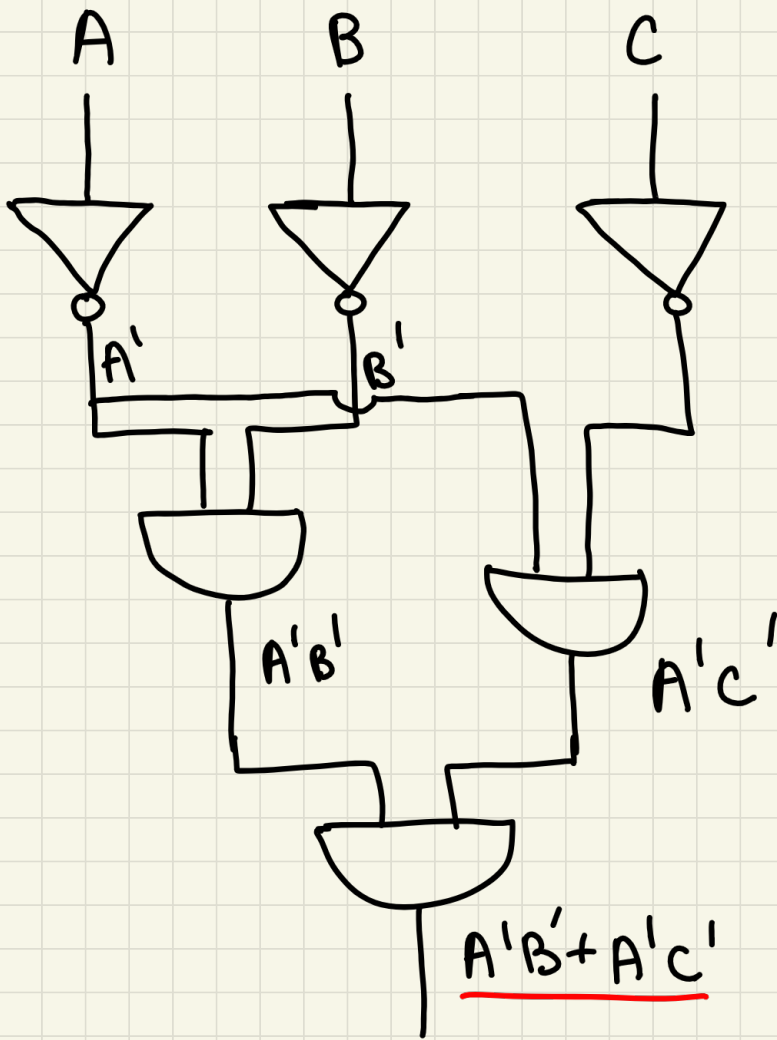
K-map

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

Groupings: G_1 (horizontal group of 1s in row 0), G_2 (vertical group of 1s in column 0).

$$G_1 = A'C' \quad G_2 = A'B'$$

$$F = A'C' + A'B'$$



b)

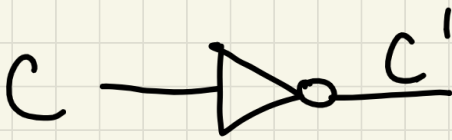
A	B	C	D	F
0	0	0	0	1
0	0	1	1	0
0	1	0	2	1
0	1	1	3	0
1	0	0	4	1
1	0	1	5	0
1	1	0	6	1
1	1	1	7	0

$$F = \sum m(0, 2, 4, 6)$$

k-map

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

$$\text{Group} = C'$$



Question 7

X	Y	Z	D _{in}	D _{out}	A	B	C
0	0	0	0	1	0	0	1
0	0	1	1	2	0	1	0
0	1	0	2	3	0	1	1
0	1	1	3	4	1	0	0
1	0	0	4	2	0	1	0
1	0	1	5	3	0	1	1
1	1	0	6	4	1	0	0
1	1	1	7	5	1	0	1

A k-map

$x \backslash yz$	00	01	11	10
0	0	0	1	0
1	0	0	1	1

Groupings: G_1 (vertical, column 11), G_2 (horizontal, row 1)

$$G_1 = YZ$$

$$G_2 = XY$$

$$A = YZ + XY$$

B k-map

$x \backslash yz$	00	01	11	10
0	0	1	0	1
1	1	1	0	0

Groupings: G_1 (vertical, column 01), G_2 (horizontal, row 1), G_3 (horizontal, row 0)

$$G_1 = Y'Z$$

$$G_2 = XY'$$

$$G_3 = X'Y_2'$$

$$B = Y'Z + XY' + X'Y_2'$$

C k-map

$x \backslash yz$	00	01	11	10
0	1	0	0	1
1	0	1	1	0

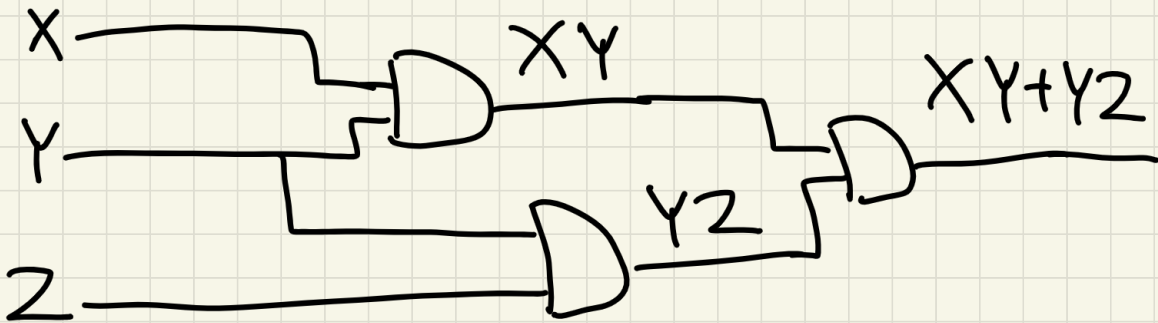
Groupings: G_1 (horizontal, row 1), G_2 (vertical, column 10)

$$G_1 = XZ$$

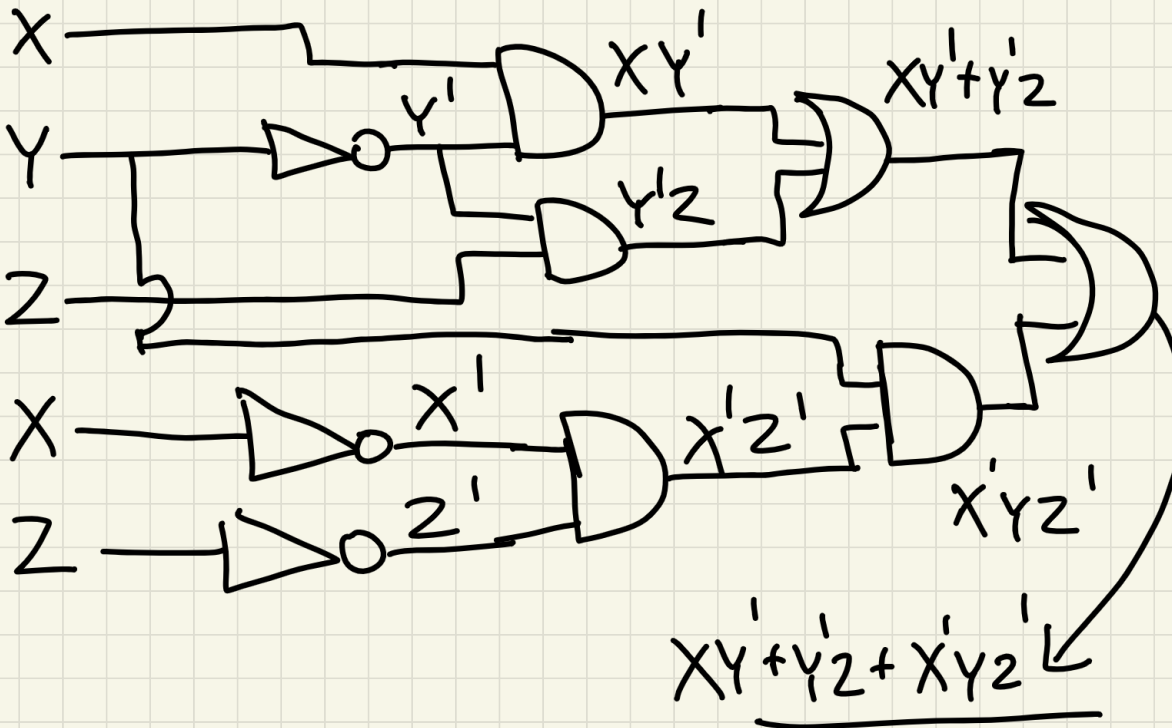
$$G_2 = X'Z'$$

$$C = XZ' + X'Z'$$

$$A = XY + YZ$$



$$B = XY' + Y'Z + X'YZ'$$



$$C = XZ + X'Z'$$

