

EE2000 - Tutorial 2

1. Minimize the following functions using Q-M method; verify your answer with K-map.

(i) $F(A, B, C, D) = \sum m(1,3,4,7,8,9,12,14)$

List 1		
Minterm	ABCD	
1	0001	✓
4	0100	✓
8	1000	✓
3	0011	✓
9	1001	✓
12	1100	✓
7	0111	✓
14	1110	✓

List 2		
Minterm	ABCD	
1,3	00-1	PI1
1,9	-001	PI2
4,12	-100	PI3
8,9	100-	PI4
8,12	1-00	PI5
3,7	0-11	PI6
12,14	11-0	PI7

	1	3	4	7	8	9	12	14
PI1	x	x						
PI2	x					x		
PI3			x				x	
PI4					x	x		
PI5					x		x	
PI6		x		x				
PI7							x	x

PI3, PI6, and PI7 are essential.

	1	8	9
PI1	X		
PI2	X		x
PI4		x	x
PI5		x	

$$f(A, B, C, D) = PI3 + PI6 + PI7 + PI1 + PI4$$

(ii) $F(A,B,C,D) = \sum m(0,1,2,5,6,7,9,10,11,13,14,15)$

List 1

Minterm	ABCD	
0	0000	√
1	0001	√
2	0010	√
5	0101	√
6	0110	√
9	1001	√
10	1010	√
7	0111	√
11	1011	√
13	1101	√
14	1110	√
15	1111	√

List 2

Minterm	ABCD	
0,1	000-	PI7
0,2	00-0	PI8
1,5	0-01	√
1,9	-001	√
2,6	0-10	√
2,10	-010	√
5,7	01-1	√
5,13	-101	√
6,7	011-	√
6,14	-110	√
9,11	10-1	√
9,13	1-01	√
10,11	101-	√
10,14	1-10	√
7,15	-111	√
11,15	1-11	√
13,15	11-1	√
14,15	111-	√

List 3

Minterm	ABCD	
1,5,9,13	--01	PI1
2,6,10,14	--10	PI2
5,7,13,15	-1-1	PI3
6,7,14,15	-11-	PI4
9,11,13,15	1--1	PI5
10,11,14,15	1-1-	PI6

$\Sigma m(0,1,2,5,6,7,9,10,11,13,14,15)$

		0	1	2	5	6	7	9	10	11	13	14	15
PI1	--01		*		*			*			*		
PI2	--10			*		*			*			*	
PI3	-1-1				*		x				*		x
PI4	-11-					*	x					*	x
PI5	1--1							*		x	*		x
PI6	1-1-								*	x		*	x
PI7	000-	x	*										
PI8	00-0	x		*									

Many combinations: (PI1 and PI2 cover 8 minterms)

$$F(A, B, C, D) = \text{PI1} + \text{PI2} + \left\{ \begin{array}{l} \text{PI3} + \text{PI5} \text{ or} \\ \text{PI3} + \text{PI6} \text{ or} \\ \text{PI4} + \text{PI5} \text{ or} \\ \text{PI4} + \text{PI6} \end{array} \right\} + \left\{ \begin{array}{l} \text{PI7} \\ \text{or} \\ \text{PI8} \end{array} \right\}$$

$$F(A, B, C, D) = C'D + CD' + \left\{ \begin{array}{l} BD + AD \text{ or} \\ BD + AC \text{ or} \\ BC + AD \text{ or} \\ BC + AC \end{array} \right\} + \left\{ \begin{array}{l} A'B'C' \\ \text{or} \\ A'B'D' \end{array} \right\}$$

(iii) $F(A,B,C,D) = \sum m(4,5,8,11,13,15) + \sum d(0,1,12)$

List 1		
Minterm	ABCD	
0	0000	√
1	0001	√
4	0100	√
8	1000	√
5	0101	√
12	1100	√
11	1011	√
13	1101	√
15	1111	√

List 2

Minterm	ABCD	
0,1	000-	√
0,4	0-00	√
0,8	-000	√
1,5	0-01	√
4,5	010-	√
4,12	-100	√
8,12	1-00	√
5,13	-101	√
12,13	110-	√
11,15	1-11	PI5
13,15	11-1	PI6

List 3

Minterm	ABCD	
0,1,4,5	0-0-	PI1
0,4,8,12	--00	PI2
4,5,12,13	-10-	PI3

$\sum m(4,5,8,11,13,15)$

		4	5	8	11	13	15
PI1	0-0-	x	x				
PI2	--00	x		x			
PI3	-10-	x	x			x	
PI4	1-11				x		x
PI5	11-1					x	x

		5	13
PI1	0-0-	x	
PI3	-10-	x	x
PI5	11-1		x

$$\begin{aligned}
 F(A,B,C,D) &= \sum m(4,5,8,11,13,15) + \sum d(0,1,12) \\
 &= \text{PI2} + \text{PI4} + \text{PI3} \\
 &= C'D' + ACD + BC'
 \end{aligned}$$