Digital Design
First Semester 2020-21
Tutorial : 04

QM Method

1. Obtain the Boolean Expression using k-map and verify with QM method

$$F(a,b,c.d) = \Sigma m(0,1,2,5,6,7,8,9,10,14)$$

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Determination of Prime Implicants

	Column I			Column II			Column III	
group 0	0	0000 ✓		0, 1	000– ✓		0, 1, 8, 9	–00–
	1	0001 ✓		0, 2	00–0 ✓		0, 2, 8, 10	–0–0
group 1	2	0010 ✓		0, 8	–000 ✓		0, 8, 1, 9	–00–
	8	1000 ✓		1, 5	0–01		0, 8, 2, 10	–0–0
	5	0101 ✓		1, 9	–001 ✓		2, 6, 10, 14	––10
	6	0110 ✓		2, 6	0–10 ✓		2, 10, 6, 14	––10
group 2	9	1001 ✓		2, 10	–010 ✓			
	10	1010 ✓		8, 9	100– ✓			
	7	0111 ✓		8, 10	10–0 ✓			
group 3	14	1110 ✓		5, 7	01–1			
				6, 7	011–			
				6, 14	–110 ✓			
				10, 14	1–10 ✓			

$$f = a'c'd + a'bd + a'bc + b'c' + b'd' + cd'$$
$$\quad (1, 5) \quad (5, 7) \quad (6, 7) \quad (0, 1, 8, 9) \quad (0, 2, 8, 10) \quad (2, 6, 10, 14)$$

$$f = a'bd + b'c' + cd'$$

1. Obtain the Boolean Expression using k-map and verify with QM method

$$F(a,b,c.d) = \Sigma m(0,1,2,5,6,7,8,9,10,14)$$

		0	1	2	5	6	7	8	9	10	14
(0, 1, 8, 9)	$b'c'$	X	X					X	⊗		
(0, 2, 8, 10)	$b'd'$	X		X				X		X	
(2, 6, 10, 14)	cd'			X		X				X	⊗
(1, 5)	$a'c'd$		X		X						
(5, 7)	$a'bd$				X		X				
(6, 7)	$a'bc$					X	X				

1. Obtain the Boolean Expression using k-map and verify with QM method

$$F(a,b,c.d) = \Sigma m(0,1,2,5,6,7,8,9,10,14)$$

		0	1	2	5	6	7	8	9	10	14
(0, 1, 8, 9)	$b'c'$	✶	✶					✶	✶		
(0, 2, 8, 10)	$b'd'$	✕		✶				✕		✕	
(2, 6, 10, 14)	cd'			✶		✶				✕	✶
(1, 5)	$a'c'd$		✕		✕						
(5, 7)	$a'bd$				✕		✕				
(6, 7)	$a'bc$					✕	✕				

2. Obtain the Boolean Expression using k-map and verify with QM method

$$F(W,X,Y,Z) = \sum m(0,3,5,6,7,10,12,13) + \sum d(2,9,15)$$

$$F(W,X,Y,Z) = \sum m(0,3,5,6,7,10,12,13) + \sum d(2,9,15)$$

Groups	Minterm ID	W	X	Y	Z	Merge Mark
G0	0	0	0	0	0	☑
G1	2	0	0	1	0	☑
G2	3	0	0	1	1	☑
	5	0	1	0	1	☑
	6	0	1	1	0	☑
	9	1	0	0	1	☑
	10	1	0	1	0	☑
	12	1	1	0	0	☑
G3	7	0	1	1	1	☑
	13	1	1	0	1	☑
G4	15	1	1	1	1	☑

Groups	Minterm ID	W	X	Y	Z
G0'	0, 2	0	0	d	0
G1'	2, 3	0	0	1	d
	2, 6	0	d	1	0
	2, 10	d	0	1	0
G2'	3, 7	0	d	1	1
	5, 7	0	1	d	1
	6, 7	0	1	1	d
	5, 13	d	1	0	1
	9, 13	1	d	0	1
	12, 13	1	1	0	d
G3'	7, 15	d	1	1	1
	13, 15	1	1	d	1

$$F(W,X,Y,Z) = \sum m(0,3,5,6,7,10,12,13) + \sum d(2,9,15)$$

Groups	Minterm ID	W	X	Y	Z	Merge Mark
G0'	0, 2	0	0	d	0	
G1'	2, 3	0	0	1	d	☑
	2, 6	0	d	1	0	☑
	2, 10	d	0	1	0	
G2'	3, 7	0	d	1	1	☑
	5, 7	0	1	d	1	☑
	6, 7	0	1	1	d	☑
	5, 13	d	1	0	1	☑
	9, 13	1	d	0	1	
	12, 13	1	1	0	d	
G3'	7, 15	d	1	1	1	☑
	13, 15	1	1	d	1	☑

Groups	Minterm ID	W	X	Y	Z
G1"	2, 3, 6, 7	0	d	1	d
	2, 6, 3, 7	0	d	1	d
G2"	5, 7, 13, 15	d	1	d	1
	5, 7, 13, 15	d	1	d	1

Groups	Minterm ID	W	X	Y	Z	Merge Mark
G0"	0, 2	0	0	d	0	
G1"	2, 3, 6, 7	0	d	1	d	
	2, 10	d	0	1	0	
G2"	5, 7, 13, 15	d	1	d	1	
	9, 13	1	d	0	1	
	12, 13	1	1	0	d	

$$F(W,X,Y,Z) = \sum m(0,3,5,6,7,10,12,13) + \sum d(2,9,15)$$

Minterm ID	$\overline{W}\ \overline{X}\ \overline{Z}$	$\overline{W}Y$	$\overline{X}Y\overline{Z}$	XZ	$WX\overline{Y}$	$W\overline{Y}Z$
0	1					
3		1				
5				1		
6		1				
7		1		1		
10			1			
12					1	
13				1	1	1

☐ E.M.T ☐ E.P.I

$$F(W,X,Y,Z) = \overline{W}\,\overline{X}\,\overline{Z} + \overline{W}Y + \overline{X}Y\overline{Z} + XZ + WX\,\overline{Y}$$