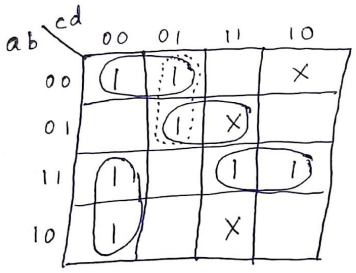
Tutorial 2(In class quiz-solutions)

1.Find the minimum sum-of-products expression for

f(a, b, c, d) = Σm(0,1, 5, 8, 12, 14, 15) +Σ d(2, 7, 11)



$$\Rightarrow \quad a\bar{c}\bar{d} + abc + \bar{a}bd + \bar{a}\bar{b}\bar{c}$$

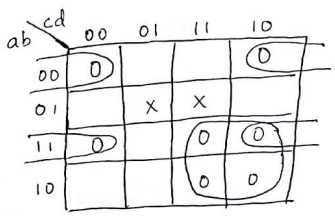
or

$$a\bar{c}\bar{d} + abc + \bar{a}\bar{c}d + \bar{a}\bar{b}\bar{c}$$

2.Find a minimum sum-of-products and a minimum product-of-sums expression for 'f' and implement using only NOR gates.

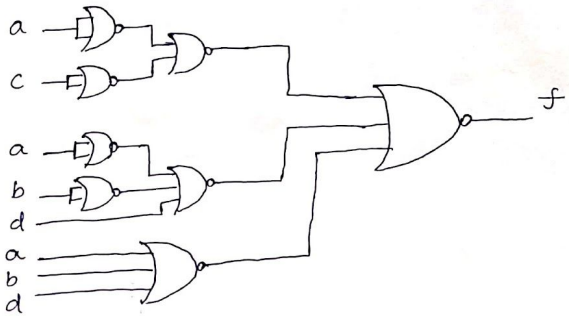
f(a, b, c,d)= **π**M(0,2,10,11,12,14,15) •**π**D(5,7)

2)



$$\Rightarrow f = (\bar{a}+\bar{c})(\bar{a}+\bar{b}+d)(a+b+d)$$

NOR gate Implementation



3.find a minimum sum-of-products solution using the Quine-McCluskey procedure.

f(a, b, c, d) = Σm(2, 3, 4, 7, 9, 11,12, 13,14) + Σd(1, 10, 15)

sol:

1	0001✓	1, 3	00-1✓	1, 3, 9, 11	-0-1	b'd
2	0010✓	1, 9	-001✓	~~1, 9, 3, 11~~	~~-0-1~~	
4	0100✓	2, 3	001-✓	2, 3, 10, 11	-01-	b'c
3	0011✓	2, 10	-010✓	~~2, 10, 3, 11~~	~~-01-~~	
9	1001✓	4, 12	-100 bc'd'	3, 7, 11, 15	--11	cd
10	1010✓	3, 7	0-11✓	~~3, 11, 7, 15~~	~~--11~~	
12	1100✓	3, 11	-011✓	9, 11, 13, 15	1--1	ad
7	0111✓	9, 11	10-1✓	~~9, 13, 11, 15~~	~~1--1~~	
11	1011✓	9, 13	1-01✓	10, 11, 14, 15	1-1-	ac
13	1101✓	10, 11	101-✓	~~10, 14, 11, 15~~	~~1-1-~~	
14	1110✓	10, 14	1-10✓	12, 13, 14, 15	11--	ab
15	1111✓	12, 13	110-✓	~~12, 14, 13, 15~~	~~11--~~	
		12, 14	11-0✓			
		7, 15	-111✓			
		11, 15	1-11✓			
		13, 15	11-1✓			
		14, 15	111-✓			

Prime implicants: *bc'd', b'd, b'c, cd, ad, ac, ab*

		2	3	4	7	9	11	12	13	14
4, 12	bc'd'			⊗				×		
1, 3, 9, 11	b'd		×			×	×			
2, 3, 10, 11	b'c	⊗	×				×			
3, 7, 11, 15	cd		×		⊗		×			
9, 11, 13, 15	ad					×	×			
10, 11, 14, 15	ac						×			
12, 13, 14, 15	ab							×	×	×

$f = \underline{b'c} + \underline{bc'd'} + \underline{cd} + b'd + ab$

$f = \underline{b'c} + \underline{bc'd'} + \underline{cd} + ad + ab$

$f = \underline{b'c} + \underline{bc'd'} + \underline{cd} + ad + ac$

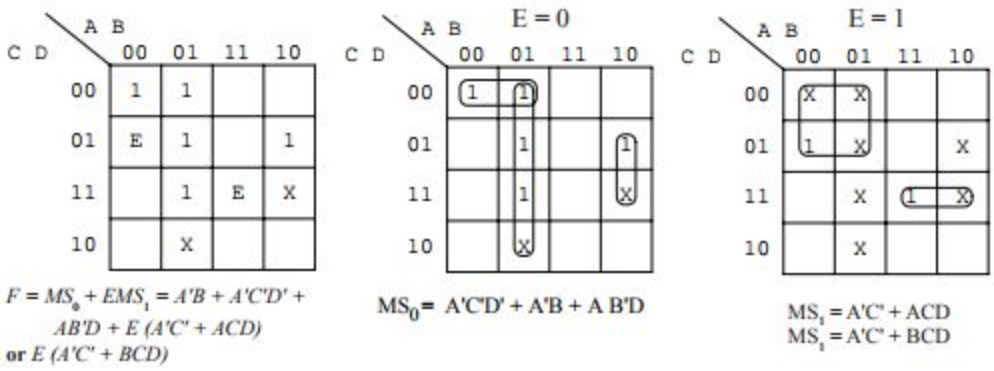
Here Essential prime implicants are b'c , bc'd' , cd

4.Using the method of map-entered variables, use 4-variable maps to find a minimum sum-of-products expression for

F{A, B, C, D, E) = Σm(0, 4, 5, 7, 9) + Σd(6, 11) + E(m1+ m15),

where the m's represent minterms of the variables A, B, C, D.

sol:



$F = MS_0 + EMS_1 = A'B + A'C'D' + AB'D + E(A'C' + ACD)$
or $E(A'C' + BCD)$

$MS_0 = A'C'D' + A'B + AB'D$

$MS_1 = A'C' + ACD$
$MS_1 = A'C' + BCD$