

Logic Design– Assignment 07

#	Student ID	Student Name	Grade (10)
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Delivery Date	
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<p>١. يتم تسليم التمرين محلولا في خلال أسبوع من تاريخ التمرين، و يتم حذف درجتين من التمرين عن كل أسبوع تأخير</p> <p>٢. يتم التسليم لمعيد المقرر مباشرة</p> <p>٣. تتم أجابه التمرين في نفس ورق الأسئلة</p>



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Q1

Find the minimum sum-of-products expression for each function. Underline the essential prime implicants in your answer and tell which minterm makes each one essential.

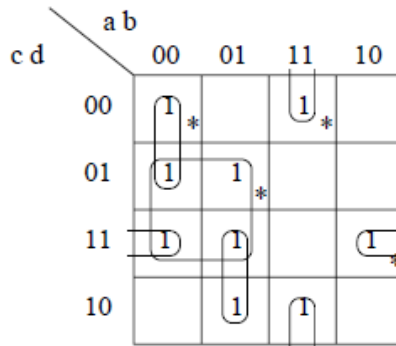
(a) $f(a, b, c, d) = \Sigma m(0, 1, 3, 5, 6, 7, 11, 12, 14)$

(b) $f(a, b, c, d) = \Pi M(1, 9, 11, 12, 14)$

(c) $f(a, b, c, d) = \Pi M(5, 7, 13, 14, 15) \cdot \Pi D(1, 2, 3, 9)$

Sol 1

(a)



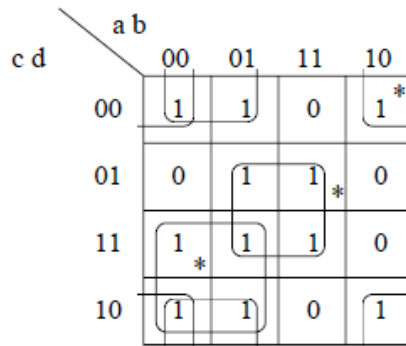
$f = \underline{a'b'c'} + \underline{a'd} + \underline{b'cd} + \underline{abd'} + bcd'$

Alt: $f = \underline{a'b'c'} + \underline{a'd} + \underline{b'cd} + \underline{abd'} + a'bc$

(*) Indicates a minterm that makes the corresponding prime implicant essential.

$a'd \rightarrow m_5; a'b'c' \rightarrow m_0; b'cd \rightarrow m_{11}; abd' \rightarrow m_{12}$

(b)



$F = \underline{a'c} + \underline{b'd'} + \underline{bd} + a'd'$

Alt: $F = \underline{a'c} + \underline{b'd'} + \underline{bd} + a'b$

(*) Indicates a minterm that makes the corresponding prime implicant essential.

$bd \rightarrow m_{13} \text{ or } m_{15}; a'c \rightarrow m_3; b'd' \rightarrow m_8 \text{ or } m_{10}$



Q2

Find the minimum sum-of-products expression for each function.

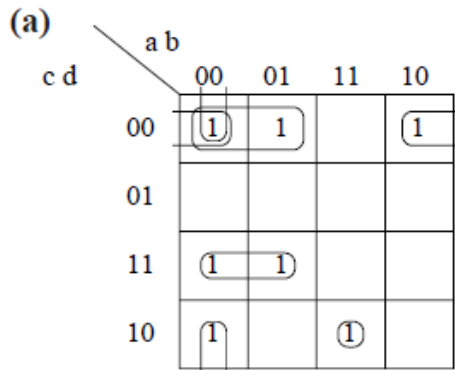
(a) $f(a, b, c, d) = \sum m(0, 2, 3, 4, 7, 8, 14)$

(b) $f(a, b, c, d) = \sum m(1, 2, 4, 15) + \sum d(0, 3, 14)$

(c) $f(a, b, c, d) = \prod M(1, 2, 3, 4, 9, 15)$

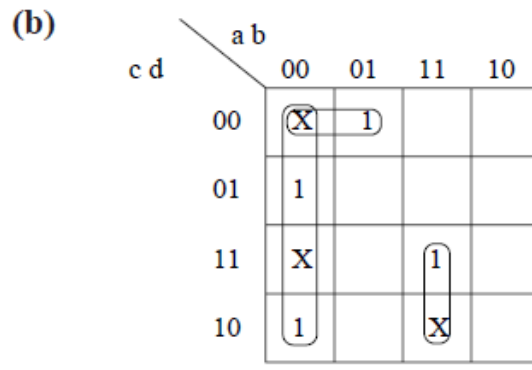
(d) $f(a, b, c, d) = \prod M(0, 2, 4, 6, 8) \cdot \prod D(1, 12, 9, 15)$

Sol
2

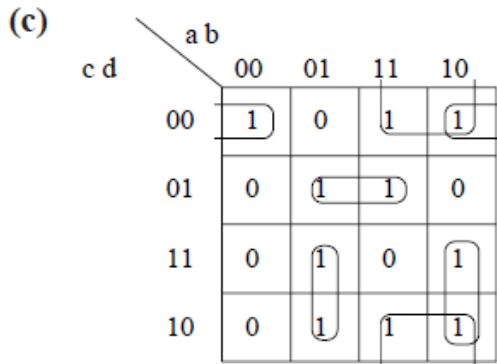


$f = a'c'd' + a'cd + b'c'd' + abcd' + a'b'd'$

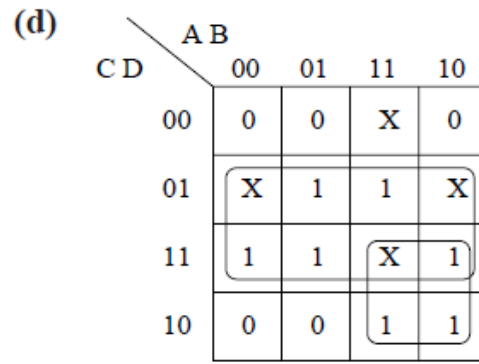
*Alt: $f = a'c'd' + a'cd + b'c'd' + abcd' + a'b'c$



$f = a'b' + a'c'd' + abc$



$f = b'c'd' + ab'c + a'bc + bc'd + ad'$



$F = D + A C$



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Q3

Find the minimum sum of products for the given expression. Then, make minterm 5 a don't-care term and verify that the minimum sum of products is unchanged. Now, start again with the original expression and find each minterm which could *individually* be made a don't-care without changing the minimum sum of products.

$$F(A, B, C, D) = A'C' + B'C + ACD' + BC'D$$

Sol
3

		A B			
		00	01	11	10
C D	00	1	1		
	01	1	1	1	
	11	1			1
	10	1		1	1

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

Minterms $m_0, m_1, m_2, m_3, m_4, m_{10},$ and m_{11} can be made don't cares, individually, without changing the given expression. However, if m_{13} or m_{14} is made a don't care, the term $BC'D$ or the term ACD' (respectively) is not needed in the expression.



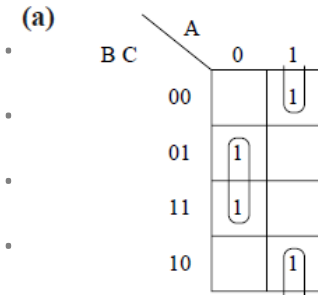
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Q4

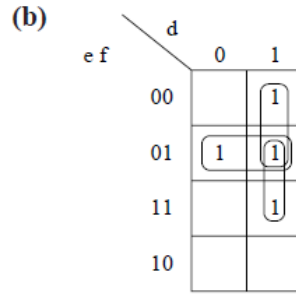
Find the minimum sum of products for each of these functions.

- (a) $f_1(A, B, C) = m_1 + m_3 + m_4 + m_6$ (b) $f_2(d, e, f) = \Sigma m(1, 4, 5, 7)$
 (c) $f_3(r, s, t) = r't' + rs' + rs$ (d) $f_4(a, b, c) = m_3 + m_4 + m_6 + m_7$
 (e) $f_2(n, p, q) = \Sigma m(2, 3, 5, 7)$ (f) $f_4(x, y, z) = M_3M_6$

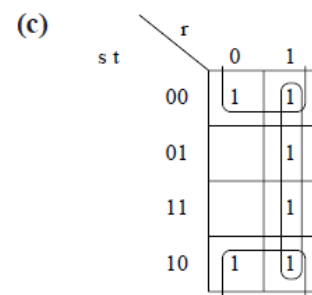
Sol 4



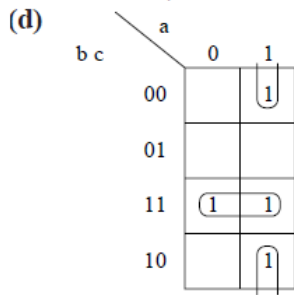
$f_1 = A'C + AC'$



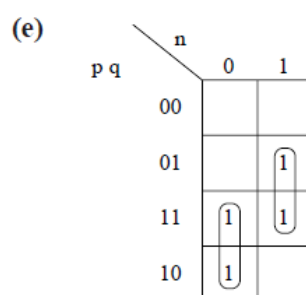
$f_2 = e'f + de' + df$



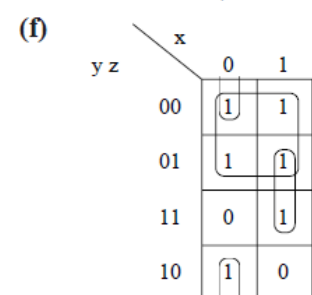
$f_3 = t' + r$



$f_1 = bc + ac'$



$f_2 = n'p + nq$



$f_4 = y' + x'z' + xz$

Q5

Find the minimum product of sums for the following. Underline the essential prime implicants in your answer.

(a) $\prod M(0, 2, 4, 5, 6, 9, 14) \cdot \prod D(10, 11)$

(b) $\sum m(1, 3, 8, 9, 15) + \sum d(6, 7, 12)$

Sol 5

(a)

C D \ A B		A B			
		00	01	11	10
C D	00	0	0		
	01		0		0
	11				X
	10	0	0	0	X

$F = \underline{(C'+D)} \underline{(A'+B+D)} \underline{(A+B+C)} \underline{(A+D)}$

(b)

C D \ A B		A B			
		00	01	11	10
C D	00	0	0	X	1
	01	1	0	0	1
	11	1	X	1	0
	10	0	X	0	0

$F = \underline{(B'+C)} \underline{(A'+B+C')} \underline{(A+D)} \underline{(C'+D)}$

Alt: $F = \underline{(B'+C)} \underline{(A'+B+C')} \underline{(A+D)} \underline{(B'+D)}$



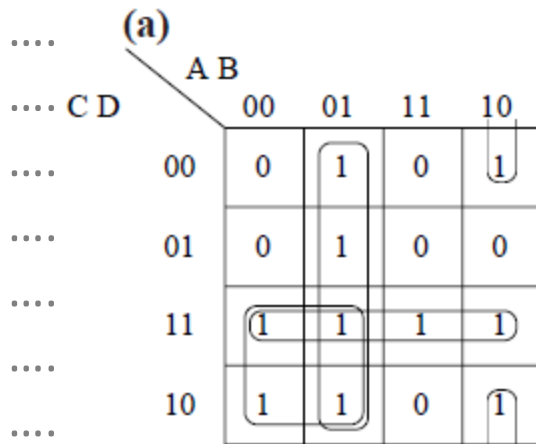
Q Given $F = AB'D' + A'B + A'C + CD$.

6 (a) Use a Karnaugh map to find the maxterm expression for F (express your answer in both decimal and algebraic notation).

(b) Use a Karnaugh map to find the minimum sum-of-products form for F' .

(c) Find the minimum product of sums for F .

So
16



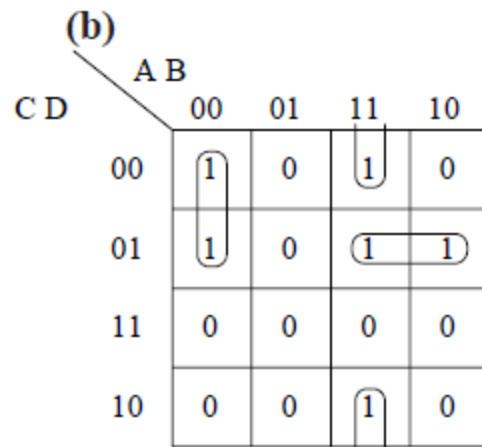
$$F = AB'D' + A'B + A'C + CD$$

$$F = \prod M(0, 1, 9, 12, 13, 14)$$

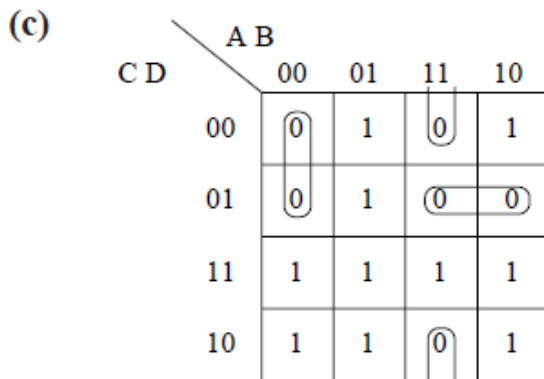
$$= (A + B + C + D)(A + B + C + D')$$

$$(A' + B + C + D')(A' + B' + C + D)$$

$$(A' + B' + C + D')(A' + B' + C' + D)$$



$$F' = ABD' + A'B'C' + AC'D$$



$$F = (A' + B' + D)(A + B + C)(A' + C + D')$$