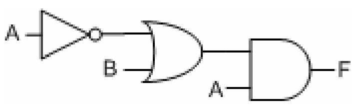
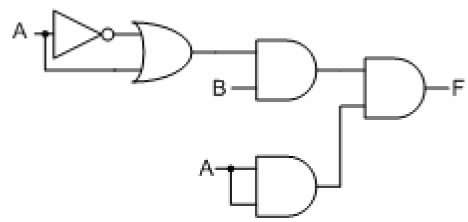
EEC 180A Practice Problems

1. Are these gate networks equivalent?



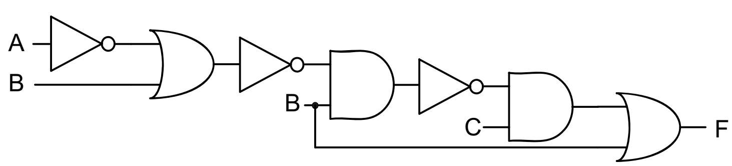


$F = (\bar{A} + B)A = AB$

$F = [(\bar{A} + A)B]A = AB$

Yes, these gate networks ARE equivalent.

2. Find the output **F** of the gate network:



F= $\overline{\left[\overline{(\bar{A} + B)} \cdot B\right]}\, C + B = (\bar{A} + B + \bar{B})C + B = B + C$

3. Use Boolean algebra to show that:

F = (A’+B’+D’)(A’+B+D’)(B+C+D)(A+C’)(A+C’+D) = A’C’D+ACD’+BC’D’

$$(A'+B'+D')(A'+B+D') = A'+D'+B\cdot B' \qquad (A+C')(A+C'+D) = A+C'(1+D)$$

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

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

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

$$= ABD' + A'BC' + BC'D' + ACD' + A'C'D = A'BC' + BC'D' + ACD' + A'C'D =$$

CONS. TERM   CONS. TERM

$$= BC'D' + ACD' + A'C'D = A'C'D + ACD' + BC'D'$$

4. Simplify the following expression using Boolean algebra:

F=BC’D’+ABC’+AC’D+AB’D+A’BD’

CONS. TERM

$$F = BC'D' + ABC' + AB'D + A'BD'$$

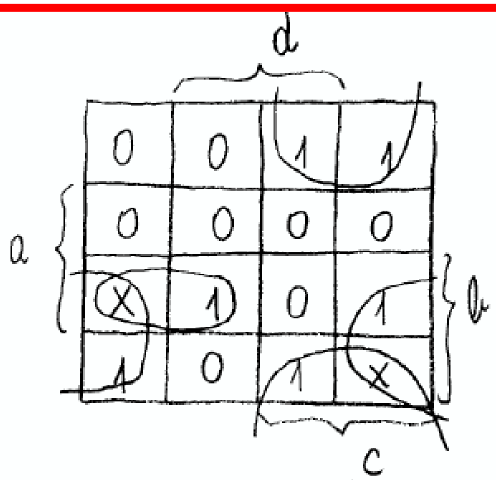
CONS. TERM

$$F = ABC' + AB'D + A'BD'$$

5. Find the minimum sum of products using Karnaugh-maps.

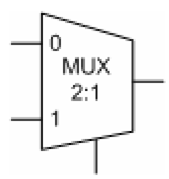
Note: D's are don't-care values.

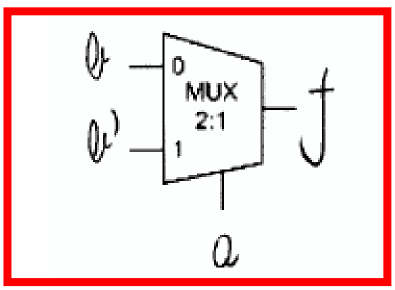
f(a, b, c, d) = Π M(0, 1, 5, 8, 9, 10, 11, 15) • Π D(6, 12)



$f = \bar{a}c + b\bar{d} + ab\bar{c}$

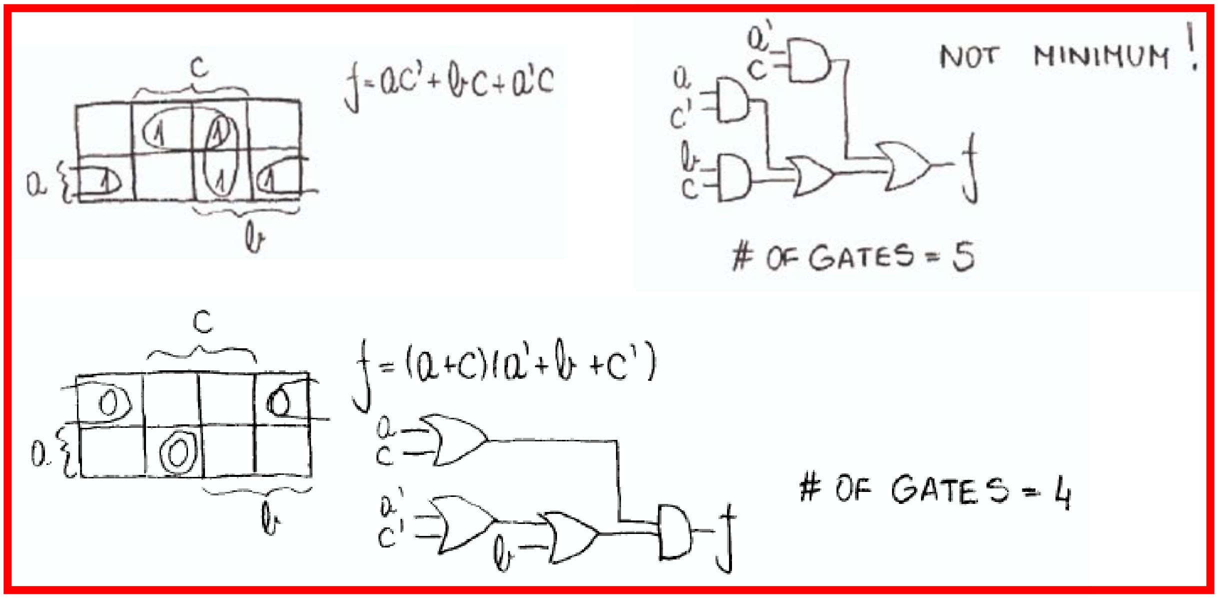
6. Realize the function **f = a'b+ab'** using 2:1 MUX





7. Implement the function **f** using a **minimum** number of 2-input AND and 2-input OR gates:

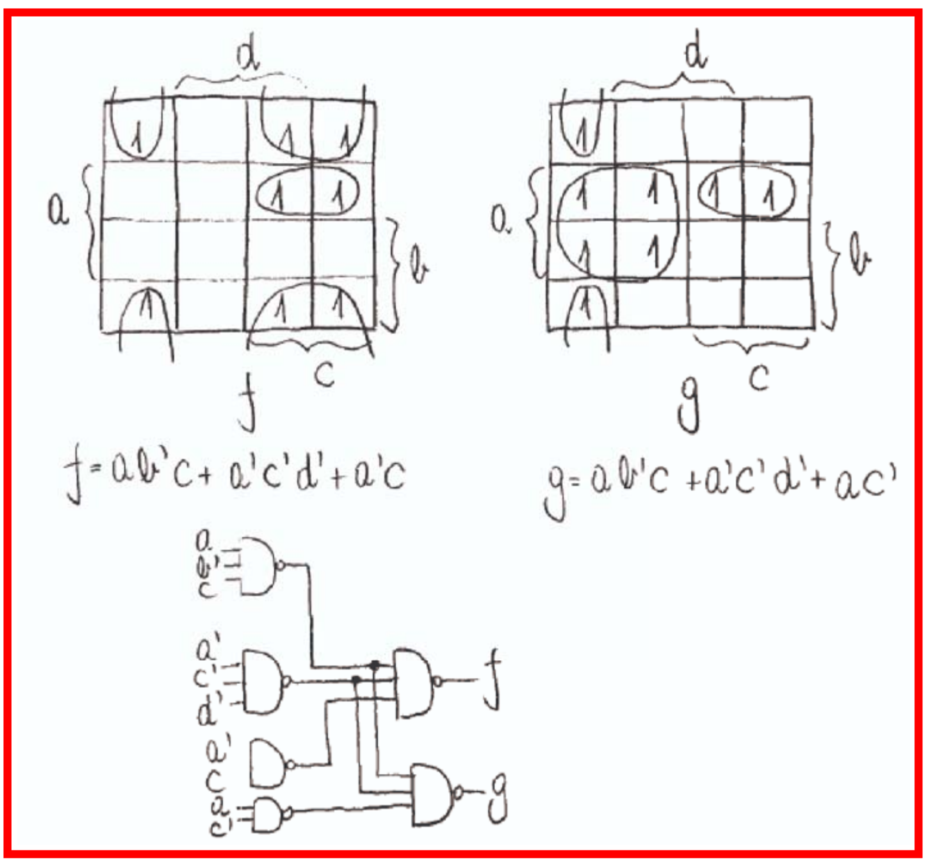
f = ab'c' + a'bc + a'c + ab



8. Using only NAND gates: minimize the total number of gates used to implement the 2-output gate network for f and g:

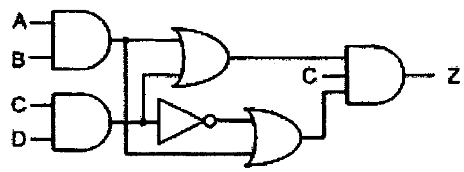
Note: Assume you have the true and complement of each input available (i.e. a and a')

f = a'c + b'c + a'd'
g = c'd' + ab' + ac'



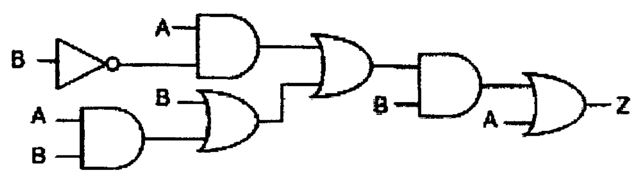
9.

(a) Simplify the following network to a single gate:



Z = $(AB+CD)(AB+\overline{CD})C = (AB+CD\cdot\overline{CD})C = ABC$

(b) Find the output Z and design a simpler network having the same output:

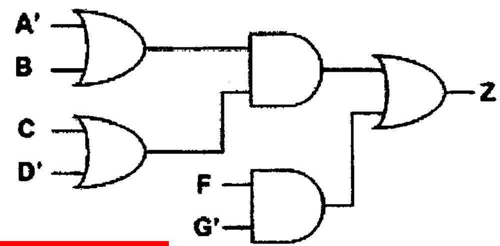


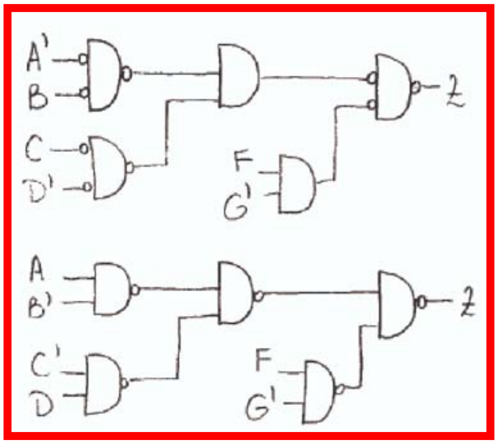
$Z = [A\overline{B} + (AB+B)]B + A =$

$(A\overline{B} + B)B + A = A\overline{B}B + B + A = A + B$

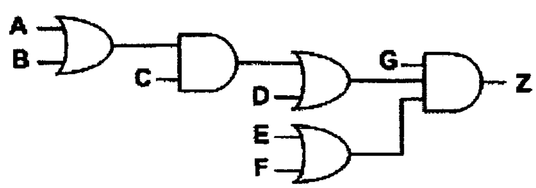
10.

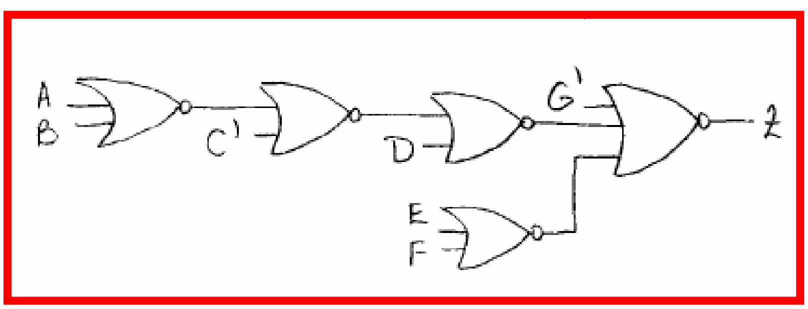
a) Convert the following circuit to all NAND gates





b) Convert the following circuit to all NOR gates





11.

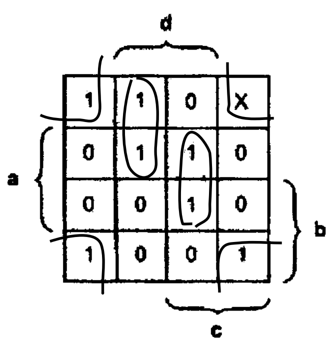
Simplify the expression using the consensus theorem

$F = A'C' + ACD + BC'D + AB'C + ABD = A'C' + ACD + AB'C + ABD =$

CONSENSUS TERM

$= A'C' + AB'C + ABD$

12.

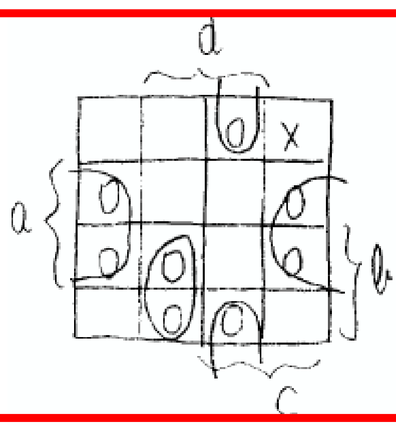


1	1	0	X
0	1	1	0
0	0	1	0
1	0	0	1

a) Find the minimum sum of products for f given in the Karnaugh-map:

f=a'd'+b'c'd+acd

b) Find the minimum product of sums for f given in the Karnaugh-map:



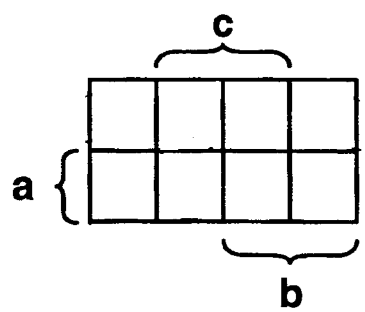
$f = (a' + d)(b' + c + d')(a + c' + d')$

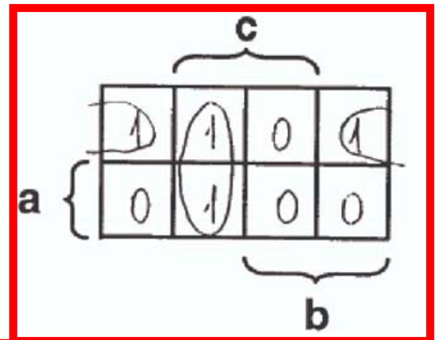
13.

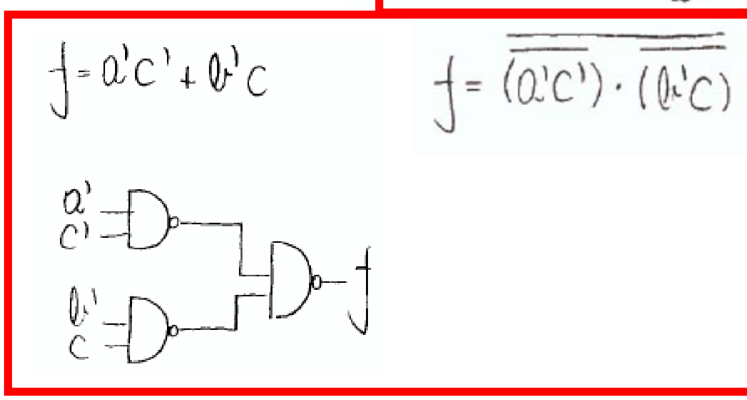
Simplify function f(a, b, c) defined in the truth-table below using Karnaugh-maps and realize it (i.e. draw the circuits) using only: (a) 2-input NAND gates and (b) 2-input NOR gates

a	b	c	f
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

a) Realize the function using 2-input NAND gates







b) Realize the function using 2-input NOR gates