CSE303 Logic Design II – Tutorial 02

#	Student ID	Student Name	Grade (10)
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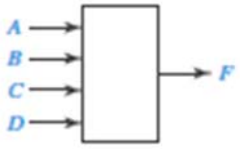
Q1

7.22 A combinational switching circuit has four inputs and one output as shown. $F = 0$ iff three or four of the inputs are 1.

(a) Write the maxterm expansion for F.

(b) Using AND and OR gates, find a minimum three-level circuit to realize F (5 gates, 12 inputs).



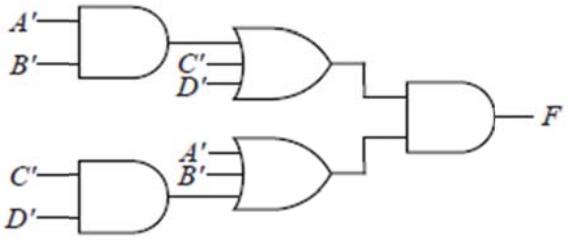
Sol 1

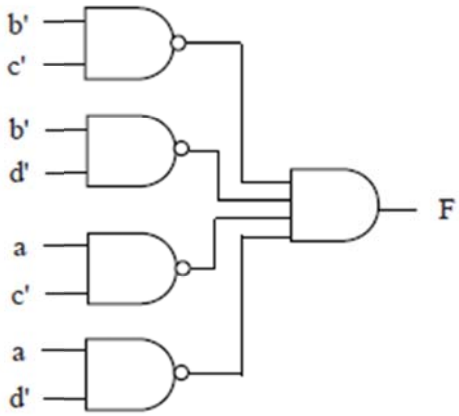
(a) F is 0 if any 3 (or 4) of the inputs are 1 so

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

(b) $F = (A' + B' + C'D')(A'B' + C' + D')$ *or*

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





Q2

7.35 Realize the following functions, using only two-input NAND gates. Repeat using only two-input NOR gates.

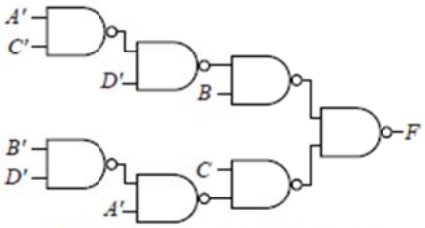
(a) $F = A'BC' + BD + AC + B'CD'$

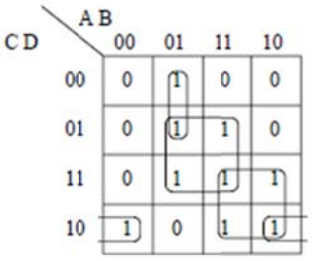
(b) $F = A'CD + AB'C'D + ABD' + BC$

Sol 2

$F = A'BC' + BD + AC + B'CD'$

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





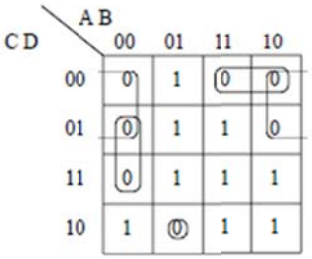
Many NOR solutions exist. Here is one.

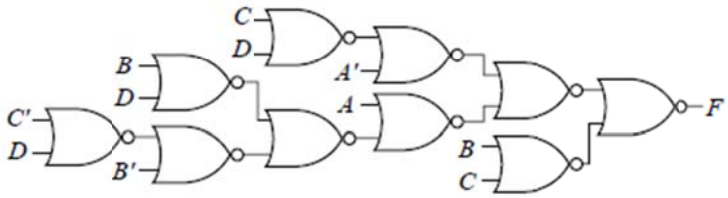
$F = (B + C)(A' + C + D)(A + B + D')(A + B' + C' + D)$

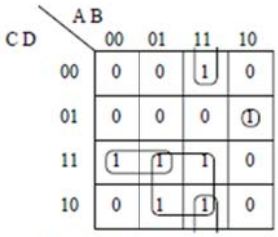
$= (B + C)[A + (B + D')(B' + C' + D)](A' + C + D)$

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

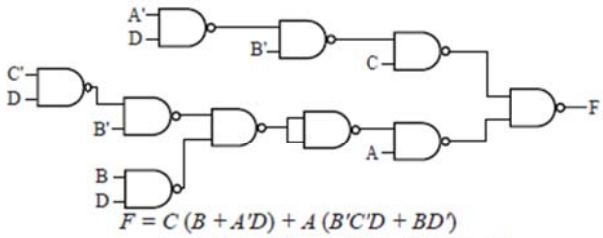
$= (B + C)[A(C + D) + A'(B(C' + D) + B'D')]$





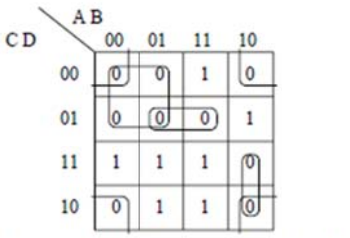


$F = A'CD + BC + AB'C'D + ABD'$

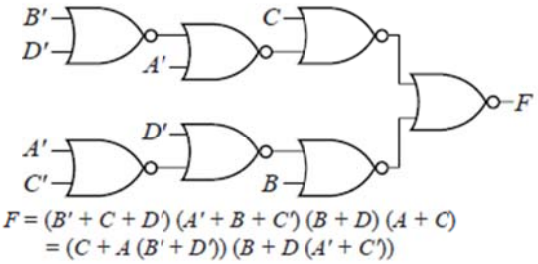


$F = C(B + A'D) + A(B'C'D + BD')$

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



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

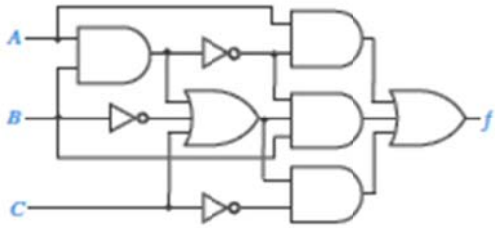


$F = (B' + C + D')(A' + B + C')(B + D)(A + C)$

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

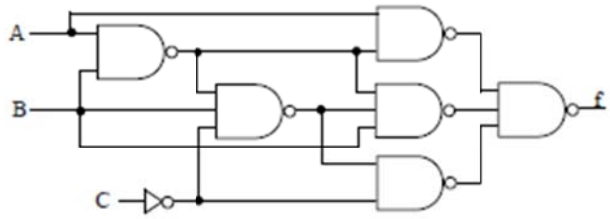
Q3

7.24 (a) Use gate equivalences to convert the circuit into a four-level circuit containing only NAND gates and a minimum number of inverters. (Assume the inputs are available only in uncomplemented form.)
(b) Derive a minimum SOP expression for f.
(c) By manipulating the expression for f, find a three-level circuit containing only five NAND gates and inverters.



Sol 3

(a)



(b) $f = A(AB)' + (AB)'[AB + B' + C]B +$
$[AB + B' + C]C'$
$= AB' + (A' + B')[AB + BC] + AC' + B'C'$
$= AB' + A'BC + AC' + B'C'$

(c) $f = A(B' + C') + A'BC + B'C'$