EE1005 – Digital Logic Design
Quiz# 3

Instructor: Muhammad Adeel Tahir   **Section:** SE-2A   **Time:** 20 Minutes

Name: _____

Roll No: _____   **Total: 10 marks**

Note: *Use the back side of the page if needed. Make sure the handwriting is neat and clean while drawing the circuit, quiz will be marked as 0 if attempted in a writing that is not readable at all.*

Q1: Simplify the following function, and implement them with two-level NAND gate circuits:
$$F(A, B, C, D) = A'B'C'D + CD + AC'D$$

Solution:

NOTE: Incase the quiz is not readable, and the handwriting and cutting is too much, 50% deduction may apply. Do not submit such cases for queries later. Such quizzes will have BH/C written on the top of their quiz meaning "bad handwriting/cutting" in bubble.

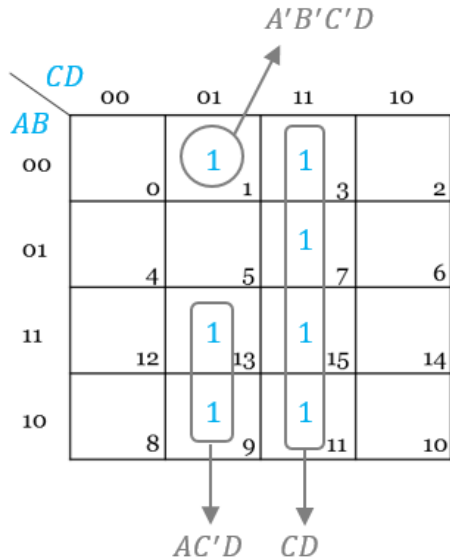The map of the given function:
$$F(A,B,C,D) = A'B'C'D + CD + AC'D$$
is as shown below in (a). This function can be simplified as shown below in (b). The simplified function is
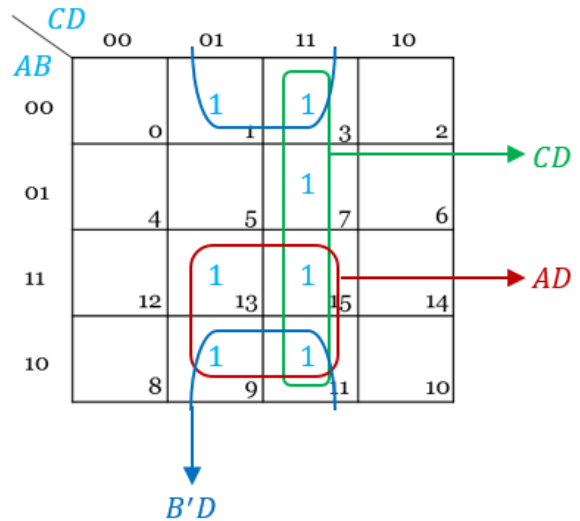$$F(A,B,C,D) = CD + AD + B'D$$
This function can be expressed as
$$F = (F')' = [(CD + AD + B'D)']' = [(CD)'(AD)'(B'D)']' \Rightarrow DeMorgan's\ theorem$$
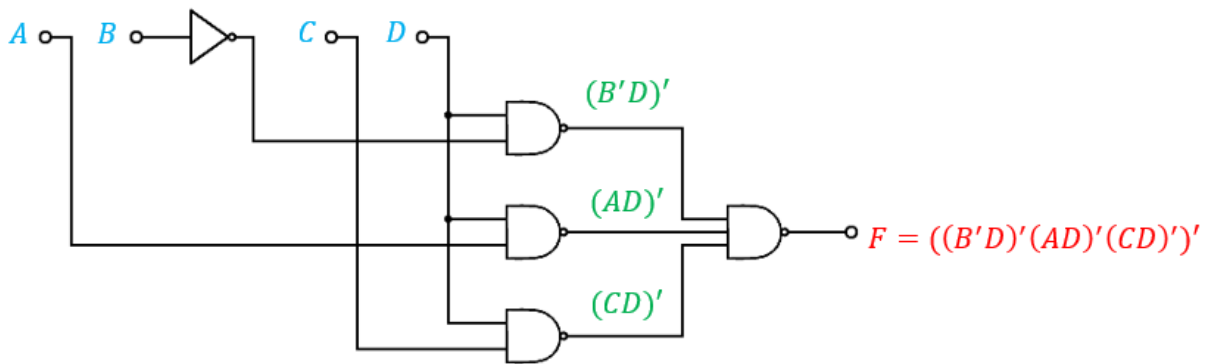Therefore, we can implement the function F using two-level NAND gate circuit as shown below in (c).

(a)

(b)

(c)

Q2: Simplify the Boolean function F(w , x , y , z) = Σ (4,5,6,7,12) with don't care function d(w ,x ,y ,z) = Σ (0,8,13). Also draw the circuit diagram.

Solution:

wx\yz	00	01	11	10
00	m0 X	m1 0	m3 0	m2 0
01	m4 1	m5 1	m7 1	m6 1
11	m12 1	m13 X	m15 0	m14 0
10	m8 X	m9 0	m11 0	m10 0

$$F(w, x, y, z) = xy' + w'x$$

Q3: Implement the following using 2 Input NOR gates only: $F = \sum(0,3,12,15)$

First, the 1's of

$$F = \sum(0, 3, 12, 15)$$

K-map plotted as shown below in (a). Then, from the 0's, we get
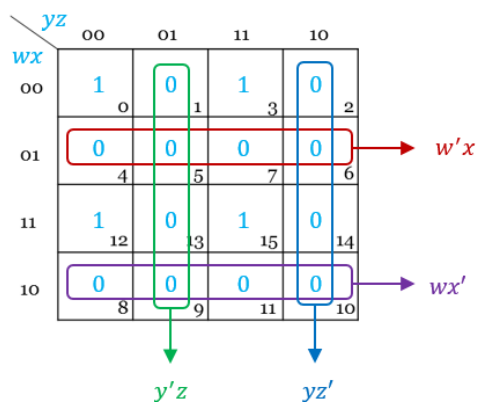
$$F' = y'z + yz' + w'x + wx'$$

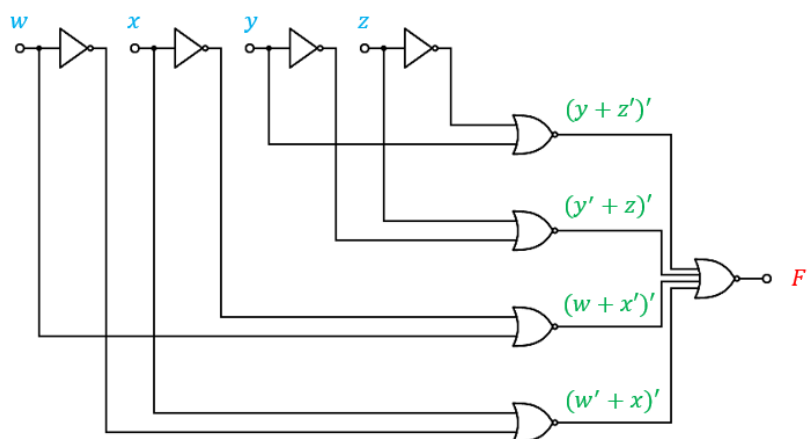The simplified function in the minimum-product-of-sums form is

$$F(w, x, y, z) = (y + z')(y' + z)(w + x')(w' + x)$$

o implement the function *F* using two-level NOR gate circuit, we reformulate the function as follows:

$$F = (F')' = [(y + z')(y' + z)(w + x')(w' + x)]''$$

$$= \{(y + z')' + (y' + z)' + (w + x')' + (w' + x)'\}'$$

(a)   (b)