DIGITAL DESIGN

ASSIGNMENT REPORT

ASSIGNMENT ID :2

PART 1: DIGITAL DESIGN THEORY

Provide your answers here:

Question1

Given the Boolean functionsF1 andF2, show that

a. The Boolean function E = F1 + F2 contains the sum of the minterms of F1 and F2

b. The Boolean function G = F1 · F2 contains only the minterms that are common to F1 and F2 .

One Boolean function can be expressed as the sum of minterms, suppose

$F1(A,B,C)= \sum m1i$, $F2(A,B,C)= \sum m2i$

a.

$E =F1+F2 = \sum m1i + \sum m2i = \sum (m1i+m2i)$

b.

$F1 \cdot F2 = \sum m1i \cdot \sum m2i,$

When $i \neq j$, then $mi \cdot mj = 0$

When i = j, then $mi \cdot mj = 1$

To satisfy $F1 \cdot F2 = 1$ in some combination of A,B,C

G can only contain the minterms that are common to F1 and F2

Question2

Convert each of the following to the other canonical form

a. $F(x, y, z) = \sum(1, 3, 7)$

b. $F(A, B, C, D) = \prod(1, 3, 5, 8, 11, 13, 15)$

a.

$(F(x,y,z))' = \sum (0,2,4,5,6)$

$((F(x,y,z))')' = F(x, y, z) = \prod(0,2,4,5,6)$

b.

$(F(A,B,C,D))' = \prod (0,2,4,6,7,9,10,12,14)$

$((F(A,B,C,D))')' = F(A,B,C,D) = \sum (0,2,4,6,7,9,10,12,14)$

Question3

Write the following Boolean expressions in:

a. (b’ + d)(a’+ b’+ c)(a + c) SOP form

b. ab + a’c’+ bc POS form

a. ab’ + b’c + cd

b. ab + a’c’ + bc = abc + abc’ + a’bc’ + a’b’c’ + a’bc = $\sum(0,2,3,6,7) = \prod(1,4,5)$

=(a+b+c’)(a’+b+c)(a’+b+c’)

Question4

Determine whether the following Boolean equation is true or false. Show your process

a. y’z’ + yz’ + x’z= x’z’

b. x’y’+ x’z’+ yz = x’y + x’z

a. False

y’z’ + yz’ + x’z = z’ + x’z = z’

b. False

Express left part and right part as POS form

left: x’y’z + x’y’z’ + x’yz’ +xyz + x’yz

right: x’yz’ + x’yz + x’y’z

thus left $\neq$ right

Question5

Simplify the following Boolean functions and expressions, using four-variable maps:

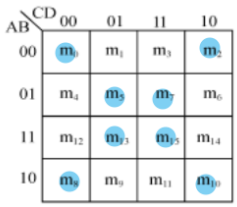
a. F (A, B, C, D) = ∑ (0, 2, 5, 7, 8, 10, 13, 15)

b. F (w, x, y, z) = ∑ (1, 3, 4, 5, 6, 7, 9, 11, 13, 15)

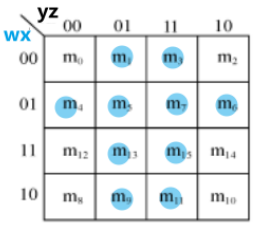
c. A'BCD+ ABC+ CD + B'D

d. A'B'C'D' + BC'D + A'C'D + A'BCD + ACD

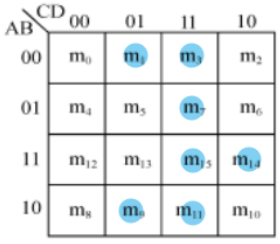
a. BD + B'D'



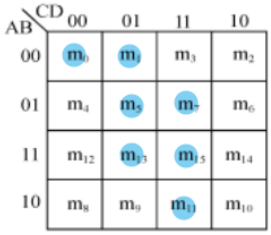
b. z+w'x



c. CD+B'D+ABC



d.BD+ACD+A'B'C'



Question6

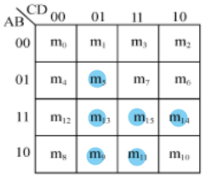
Implement the following logical functions with two-level NOR gate circuits.

Write down the simplification process, then draw the circuit diagram.

a. F(A, B, C, D) = AD+ BC'D+ ABC + A'BC'D

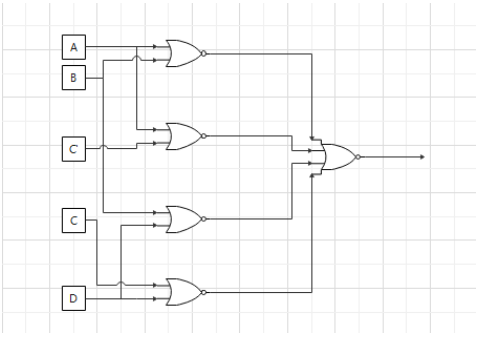
b. F(A, B, C, D)= (A'+ C'+ D')(A'+ C')(C'+ D')

a.

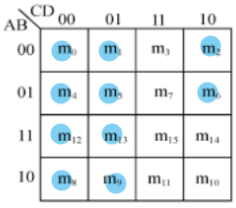


F' = A'B'+C'D'+A'C+B'D'=(A+B)'+(C+D)'+(A+C')'+(B+D)'

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



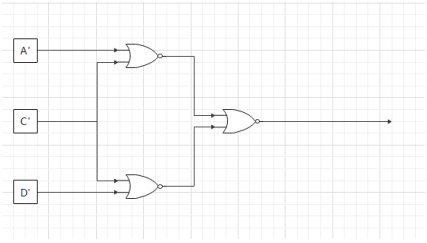
b.



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

F' = CD+AC = (C'+D')' + (A'+C')'

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



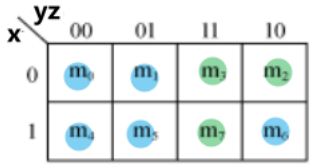
Question7

Simplify the following Boolean function F, together with the don't-care conditions d, and then express the simplified function in sum-of-minterms form:

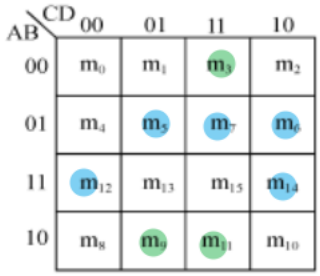
a. F(x, y, z) = ∑(0, 1, 4, 5, 6) with d(x, y, z)= ∑(2, 3, 7)

b. F(A, B, C, D) = ∑(5, 6, 7, 12, 14)with d(x, y, z)= ∑(3, 9, 11)

a. F(x,y,z) = 1 = ∑(1,2,3,4,5,6,7)



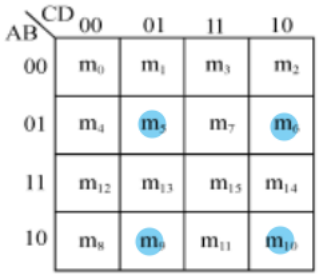
b. F(A,B,C,D) = A'BD + A'BC + ABD' = ∑(5,6,7,12,14)



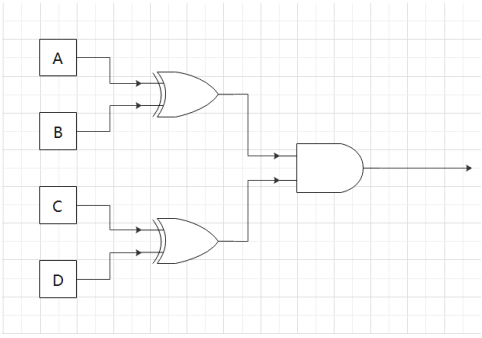
Question8

Implement the following Boolean expression with exclusive-OR and AND gates, draw the circuit diagram: F = AB'CD' + A'BCD' + AB'C'D + A'BC'D

In four-variables map, F is as follow



F = A'B(CD'+C'D) + AB'(CD'+C'D) = (CD'+C'D)(A'B + AB') = (A⊕B)(C⊕D)



PART 2: DIGITAL DESIGN LAB (TASK1)

All the tasks have been checked in-class