BBM 231 Logic Design - Midterm 1

Date : November 19, 2018 DURATION : 100 MINUTES

Name Last Name :
Section : Signature:

Question	1	2	3	4	Total
Points	25	25	25	25	100
Points Taken					

Question 1 (5 points each)

Given a Boolean function F = BC + A'BC + AB'C

a. Fill the truth table for F (7.5 points).

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

b. Write F in Sum-of-Minterms (SOM) form (5 points).

$F = \Sigma(3,5,7) = A'BC + AB'C + ABC$

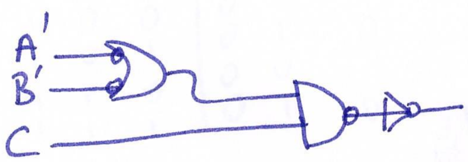
c. Minimize F using Karnaough-Map method (7.5 points).

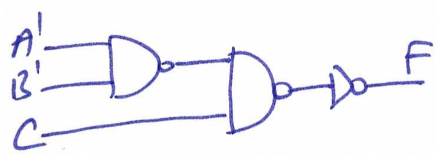
A \ BC	00	01	11	10
0	0	0	1	0
1	0	1	1	0

$F = AC + BC$
$= C(A+B)$

$(F')' = (C' + A'B')'$
$F = C \cdot (A+B)$

d. Implement the ***optimized circuit*** with **only NAND** gates (5 points).





Question 2.

Design a circuit that detects prime numbers **from 0 to 13** (Output should be one when the decimal value of the input is a prime number). Just give the function in the most simplified form. Do not draw the circuit.

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	X
1	1	1	1	X

AB \ CD	00	01	11	10
00			1	1
01		1	1	
11		1	X	X
10			1	

$$\boxed{F = CD + BD + A'B'C}$$

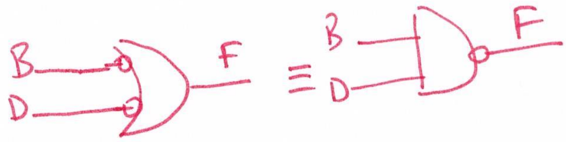
Question 3.

You are given two functions as $F1(A,B,C,D) = \sum(0,2,8,10)$ and $F2(A,B,C,D) = A'BD + ABC'D + ABCD$. Implement $F = F1 \text{ OR } F2'$ using minimum number of NAND gates.

A	B	C	D	F1	F2	F2'	F
0	0	0	0	1	0	1	1
0	0	0	1	0	0	1	1
0	0	1	0	1	0	1	1
0	0	1	1	0	0	1	1
0	1	0	0	0	0	1	1
0	1	0	1	0	1	0	0
0	1	1	0	0	0	1	1
0	1	1	1	0	1	0	0
1	0	0	0	1	0	1	1
1	0	0	1	0	0	1	1
1	0	1	0	1	0	1	1
1	0	1	1	0	0	1	1
1	1	0	0	0	0	1	1
1	1	0	1	0	1	0	0
1	1	1	0	0	0	1	1
1	1	1	1	0	1	0	0

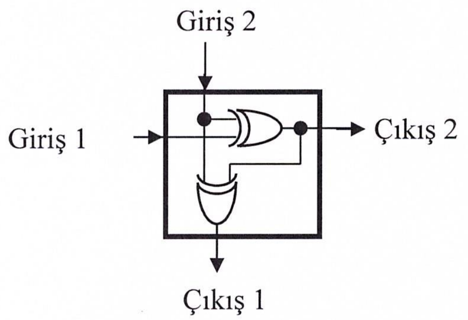
AB \ CD	00	01	11	10
00	1	1	1	1
01	1			1
11	1			1
10	1	1	1	1

$$F = D' + B'$$

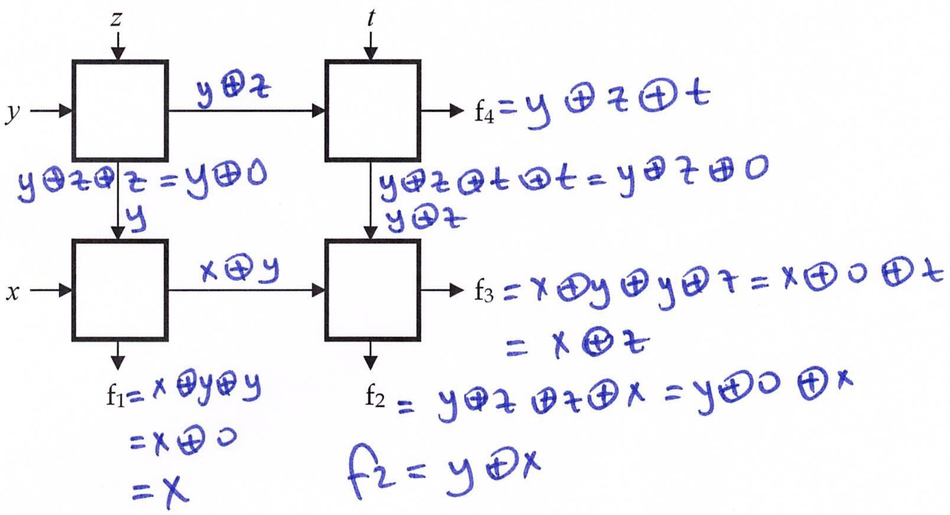


Question 4.

A logic unit has the following internal connection structure.



By using this unit; a system, shown below, is constructed. What are the most simple output of the functions f_1, f_2, f_3 and f_4? You have to give your answer by using only XOR ($\oplus$) operation.



$f_1 = x$

$f_2 = x \oplus y$

$f_3 = x \oplus z$

$f_4 = y \oplus z \oplus t$