21.5/25

EE345 - Introduction to Microcontrollers **Exam 2** **27th Nov. 2016** **B**

Student Name: يزن نعمان حسن زايد **Student No.:** 201500 24033

Problem 1 (5 points)

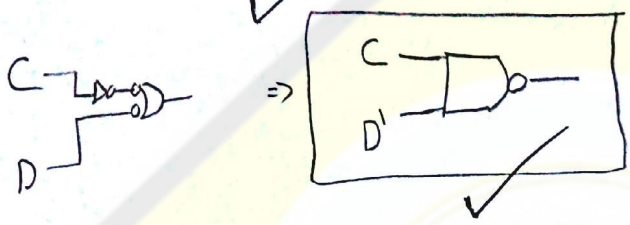
Simplify the following function, and implement it with NAND gates:

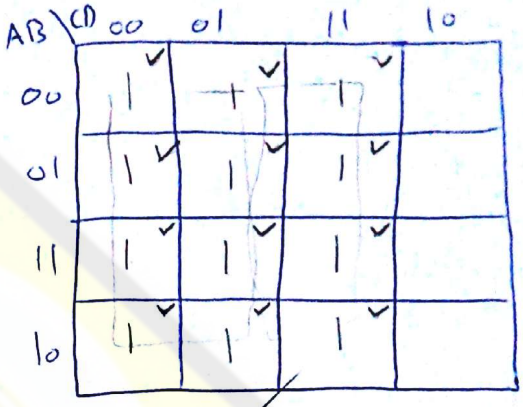
F(A, B, C, D) = AC'D' + A'D + ABD + AB'D + A'C'D'

5

ABC'D' AB'C'D'

F = C' + D





Problem 2 (6 points)

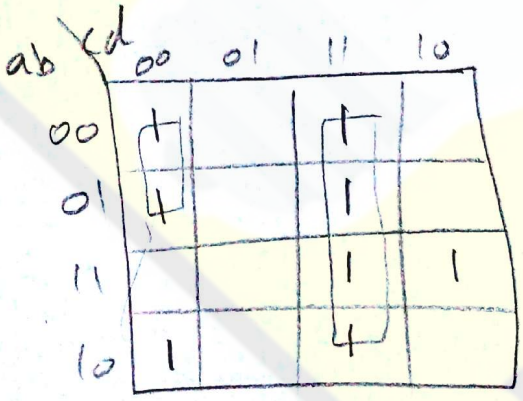
With the use of maps, find the simplest sum-of-products form of the function *F* = *fg*, where

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

g = a'c' + c'd' + b'd' + acd + bcd

4.5

f' = a'c'd' + b'c'd' + cd + abc



f' = cd + a'c'd' ?

g = b'd' +

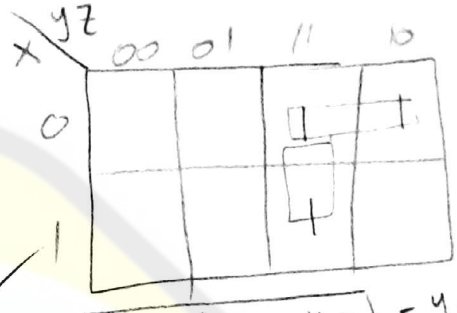
F map ?

Scanned by CamScanner

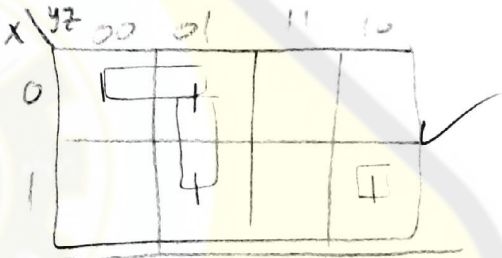
Problem 3 (8 points)

Design a combinational circuit with three inputs, *x*, *y*, and *z*, and three outputs, *A*, *B*, and *C*. When the binary input is 0, 1, 2, or 3, the binary output is two greater than the input. When the binary input is 4, 5, 6, or 7, the binary output is three less than the input.

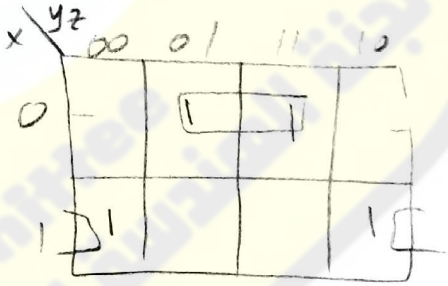
	inputs			outputs			
	x	y	z	A	B	C	
0	0	0	0	0	1	0	0+2
1	0	0	1	0	1	1	1+2
2	0	1	0	1	0	0	2+2
3	0	1	1	1	0	1	3+2
4	1	0	0	0	0	1	4-3
5	1	0	1	0	1	0	5-3
6	1	1	0	0	1	1	6-3
7	1	1	1	1	0	0	7-3



$A = x'y + yz = y(x'+z)$

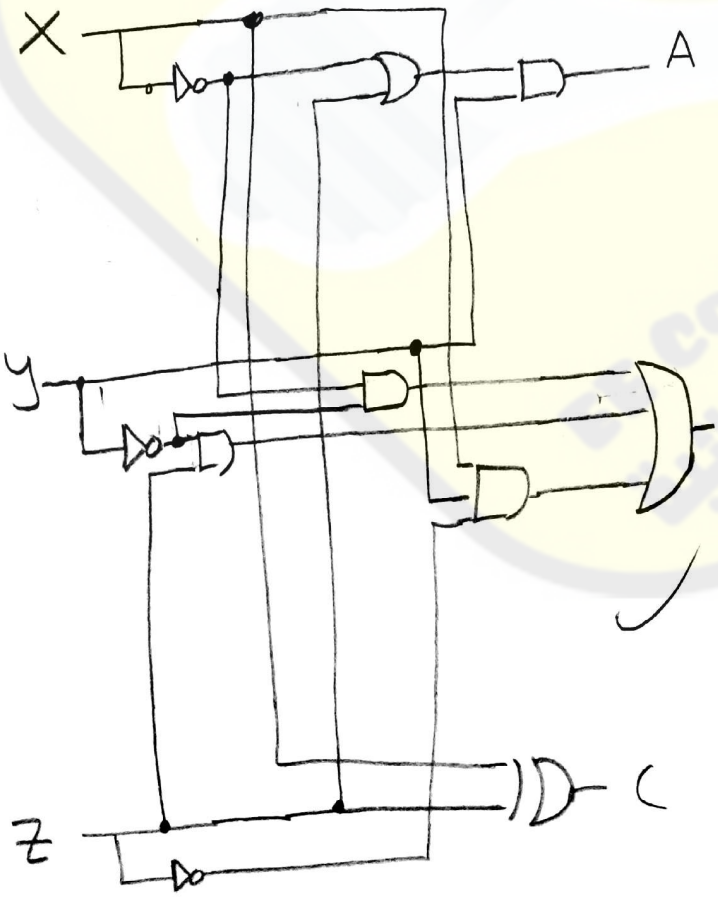


$B = y'z + x'y' + xyz'$



$C = x'z + xz'$

$C = x \oplus z$



Scanned by CamScanner

6

Problem 4 (6 points)

A sequential circuit has two JK flip-flops A and B and one input x. The circuit is described by the following flip-flop input equations:

$J_A = x$ $K_A = B'$ $J_B = x$ $K_B = A$

(a) Derive the state equations A(t + 1) and B(t + 1) by substituting the input equations for the J and K variables.

(b) Write down the state table and draw the state diagram of the circuit.

=> Characteristic Equation:

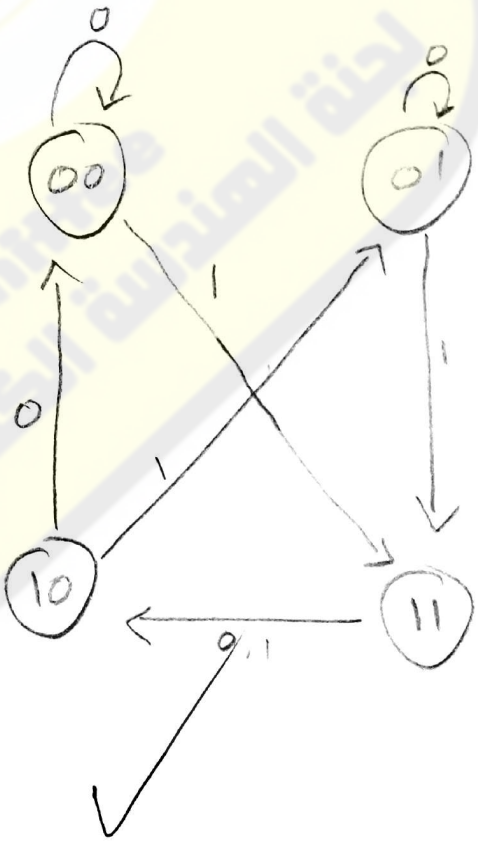
$$Q(t+1) = JQ' + K'Q$$

=> $A(t+1) = J_A A' + K_A' A$ ($J_A = x$, $K_A = (B')'$) => $A(t+1) = xA' + AB$ ✓

=> $B(t+1) = J_B B' + K_B' B$ ($J_B = x$, $K_B = A'$) => $B(t+1) = xB' + A'B$ ✓

Present state		input	Next state	
A	B	x	A	B
0	0	0	0	0
0	0	1	1	1
0	1	0	0	1
0	1	1	1	1
1	0	0	0	0
1	0	1	0	1
1	1	0	1	0
1	1	1	1	0

✓



Scanned by CamScanner