EEN 220 LOGIC DESIGN — FALL 2002, TEST 1, 50 MINUTES — ECCE DEPARTMENT, NDU, S.C.ELMURR

NOTE1: OPEN BOOK, OPEN NOTES.
NOTE2: SHOW ALL WORK IN ORDER TO RECEIVE FULL CREDIT.

1. 20Pts. Perform the base conversions indicated below.

$(2051.8125)_{10} = (\qquad)_{16} = (\qquad)_{8} = (\qquad)_{2}$
$(6721.3)_8 - (FFF.D)_{16}$ using two's complement arithmetic.

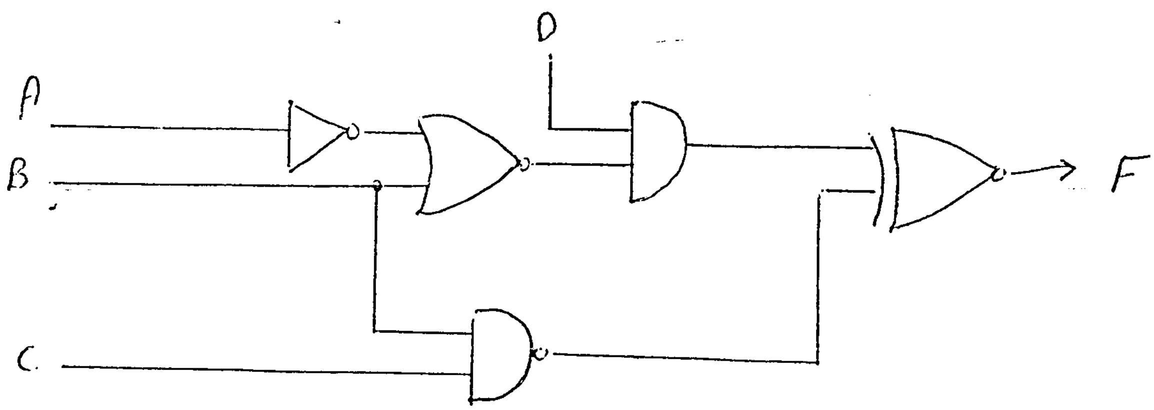
2. 20 Pts: Simplify to a sum of three terms using Boolean algebra.

a) A'C'D' + AC' + BCD + A'CD' + A'BC + AB'C'
b) A'B'C' + ABD + A'C + A'CD' + AC'D + AB'C'

3. 40 Pts. Determine which of the following Boolean functions are equivalent:

$F_1(A,B,C,D) = AB'C' + AB'D + AB'C + BD + A'B'D' + B'C'D' + AD$
$F_2(A,B,C,D) = \prod M(4, 8, 9, 11, 12, 13)$
$F_3(A,B,C,D) = \sum m(0, 2, 5, 7, 8, 9, 10, 11, 13, 15)$
$F_4(A,B,C,D) = ((A'B')' (A'D)' (A'C)' (BC)' (CD')' (ABC)' (ACD')')'$
$F_5(A,B,C,D) = ((B'+C+D)'+(B'+C'+D)'+(A'+B+D')'+(A'+B'+D)'+(A+B'+D)')'$
$F_6(A,B,C,D) = A'B' \oplus CD' \oplus BC \oplus A'D \oplus A'BD \oplus BCD' \oplus A'BC'D \oplus A'B'C \oplus A'B'C'D$

4. 20 Pts. Find the minterm and maxterm list forms for the function defined by the logic diagram below:



Section : NWE : 11 → 12
DR. S. NVFR

N°1) a) $(2051)_{10} = 100000000011$

$0.8125 \times 2 = 0.625 + 1$
$0.625 \times 2 = 0.25 + 1$
$0.25 \times 2 = 0.5 + 0$
$0.5 \times 2 = 0.0 + 1$

$(2051.8125)_{10} = (100000000011.1101)_2 = (803.D)_{16}$

$= (4003.64)_8$

b) $(6721.3)_8 = (110111010001.011)_2$

$(FFF.D)_{16} = (111111111111.1101)_2$

0110111010001.0110
0111111111111.1101

0 | 0110111010001.0110
1 | 1000000000000.0011 (2's comp)

1 | 1110111010001.1001

$= -(0001000101110.0111)_2$

2⁰ 2 4⁰ 2⁰

N°2)

a) $A'C'D' + AC' + BCD + A'CD' + A'BC + AB'C'$ $+ABC'D + ABC'$

$A'C'D' + AC'D' + AC'D + ABCD + A'BCD + A'BCD' + A'BC'D + ABCD + A'BCD'$

$C'D'$

$= C'D' + AC'D + ABCD + A'BCD + A'BCD' + A'B'CD' + AB'C'D + AB'C'D'$

$= AC'D' + AC'D + ABC'D + AB'C'D + ABCD + A'BCD + A'BCD' + A'B'CD' + A'B'CD$
$+ AB'C'D'$

$= ABC'D' + AB'C'D' + A'BC'D' + A'B'C'D' + ABC'D + AB'C'D + ABCD + A'BCD + A'BCD'$
$+ A'B'CD' + A'B'C'D$
$+ AB'C'D'$

a) $\cancel{AC'B' + AB'}$

$AC' + AC'B' + A'D'C' + A'D'C + BCD + BCA'$

$AC' + A'D' + BC(A' + D)$

$AC' + A'D' + A'BC + BCD$

$AC' + A'D' + BCD + A'BC$

$AC' + A'D' + BCD + A'BCD' + A'BCD$

$AC' + BCD + A'D'$

b) $(A'B'C' + AB'C') + (ABB + ADC') + (A'C + A'CD')$

$B'C' + AD(B + C') + A'C$

$B'C' + A'C' + ABD + AC'D$

$\to ABC'D$

$\to ABC'D$

$A'C + B'C' + ABD$

N°3) $F_1(A,B,C,D) = AB'C' + AB'D + AB'C + BD = A'B'D' + B'C'D' + AD$

A

1			1
	1	1	1
	1	1	1
1			1

C, D

B

$F_2(A,B,C,D) = \Sigma m(0,1,2,3,5,6,7,10,14,15)$

$= \Pi M(4, 8, 9, 11, 12, 13)$

A

1	0	0	0
1	1	0	0
1	1	1	0
1	1	1	1

C, D

B

$F_3(A,B,C,D) = \Sigma m(0, 2, 5, 7, 8, 9, 10, 11, 13, 15)$

A

1			1
	1	1	1
	1	1	1
1			1

C, D

B

f_4 = Using demorgan's theorem

$$f_4 = A'B' + A'D + A'C + BC + CD' + ABC + ACD'$$

A

1			
1	1		
1	1	1	
1	1	1	1

D

C

B

f_5 = Using demorgan's theorem

$$f_5' = (B'+C+D)' + (B'+C'+D)' + (A'+B+D')' + (A'+B'+D)' + (A+B'+D)'$$

Demorgan's theorem

$$f_5' = BC'D' + BCD' + AB'D + ABD' + A'BD'$$

A

1	0	0	1
1	1	1	0
1	1	1	0
1	0	0	1

D

C

B

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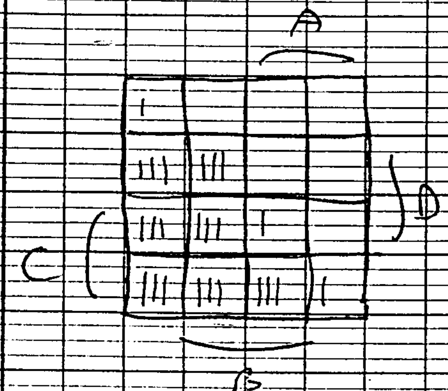
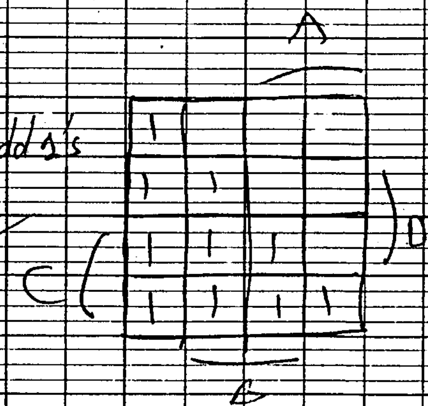
$$F_6(A,B,C,D) = A'B' \oplus CD' \oplus BC \oplus A'D \oplus A'BD \oplus BCD' \oplus$$
$$A'BC'D \oplus A'B'C \oplus A'B'C'D$$



Number of odd 1's

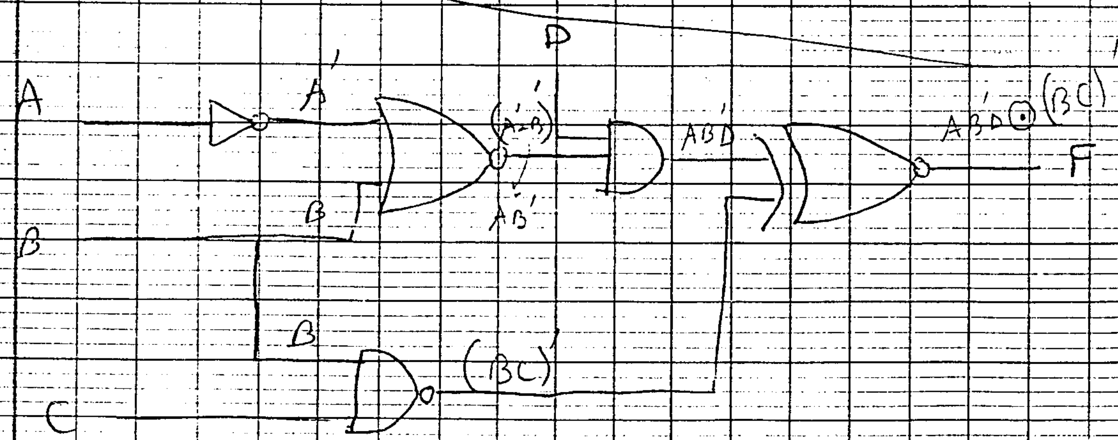


$\Rightarrow$ $F_1 = F_3$

$F_2 = F_6 = F_4$

F_5

N; 4)



$$\cancel{A'B'D \odot (BC)' = (A'B'D)(BC)' + (A'B'D)'(BC)}$$

$\cancel{F = AB'D(B'+C)' + (A+B+D)'(BC)'}$

$\cancel{= AB'C'B' \ldots + A'BC}$

$$F = AB'D \odot (BC)' = \left(AB'D \oplus (BC)'\right)'$$

$$= \left((AB'D)'(BC)' + AD\underbrace{B'B}_{0}C\right)'$$

$$= \left((A'+B+D')(B'+C')\right)'$$

$$= \left(A'B' + A'C' + \underbrace{BB'}_{0} + BC' + B'D' + C'D'\right)'$$

			A	A	
	0	0	0	0	
	0	0	0	1	D
C	0	1	1	1	D
C	0	1	1	0	
		B	B		

$$F = \Pi M(0,1,2,3,4,5,8,10,12,13)$$

$$= \Sigma m(6,7,9,11,14,15)$$