Switching Circuits & Logic Design, Fall 2003
Midterm Solution

1. (7%)

(a) 2's complement (4%)

-Y=	0	1	1	1	1	0	1
X-Y:	1	0	1	0	1	0	0
	0	1	1	1	1	0	1
~~1~~	**0**	**0**	**1**	**0**	**0**	**0**	**1**

-X=	0	1	0	1	1	0	0
Y-X:	1	0	0	0	0	1	1
	0	1	0	1	1	0	0
	1	**1**	**0**	**1**	**1**	**1**	**1**

(b) 1's complement (3%)

-Y=	0	1	1	1	1	0	0
X-Y:	1	0	1	0	1	0	0
	0	1	1	1	1	0	0
1	0	0	1	0	0	0	0
							1
	0	**0**	**1**	**0**	**0**	**0**	**1**

-X=	0	1	0	1	0	1	1
Y-X:	1	0	0	0	0	1	1
	0	1	0	1	0	1	1
	1	**1**	**0**	**1**	**1**	**1**	**0**

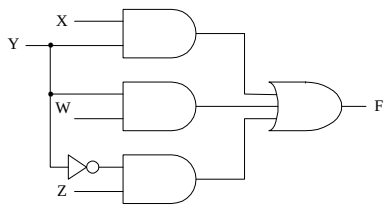
2. (8%)

(a) (2%)

W	X	Y	Z	XY'Z	X'Y'Z	W'XY	WX'Y	WXY	F
0	**0**	**0**	**0**	0	0	0	0	0	**0**
0	**0**	**0**	**1**	0	1	0	0	0	**1**
0	**0**	**1**	**0**	0	0	0	0	0	**0**
0	**0**	**1**	**1**	0	0	0	0	0	**0**
0	**1**	**0**	**0**	0	0	0	0	0	**0**
0	**1**	**0**	**1**	1	0	0	0	0	**1**
0	**1**	**1**	**0**	0	0	1	0	0	**1**
0	**1**	**1**	**1**	0	0	1	0	0	**1**
1	**0**	**0**	**0**	0	0	0	0	0	**0**
1	**0**	**0**	**1**	0	1	0	0	0	**1**
1	**0**	**1**	**0**	0	0	0	1	0	**1**
1	**0**	**1**	**1**	0	0	0	1	0	**1**
1	**1**	**0**	**0**	0	0	0	0	0	**0**
1	**1**	**0**	**1**	1	0	0	0	0	**1**
1	**1**	**1**	**0**	0	0	0	0	1	**1**
1	**1**	**1**	**1**	0	0	0	0	1	**1**

(b) $F(W,X,Y,Z) = XY'Z + X'Y'Z + W'XY + WX'Y + WXY = \underline{\mathbf{Y'Z+XY+WY}}$
or $\underline{\mathbf{(Y+Z)(W+X+Y')}}$ (4%)

(c) (2%)



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Midterm Solution

3. (10%)

(a) (5%) LHS = ab+c'd'+a'bcd'+ab'c'd = a(b+c'd')+d'(c'+a'b) = c'(a+d')+b(a+d')

= **(a+d')(b+c') ≠ (a+d')(b'+c')** ∴ **LHS≠RHS**

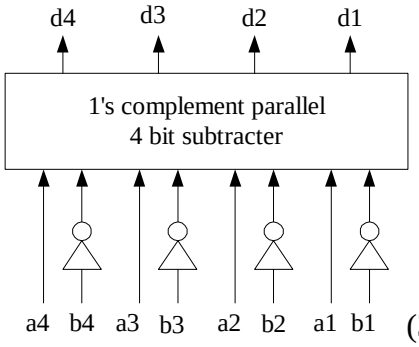
(b) (5%) LHS = (a+b)(b+c)(c+a) = bc+ac+ab

RHS = (a'+b')(b'+c')(c'+a') = b'c'+a'c'+a'b' ∴ **LHS≠RHS**

4. (15%)

(a) (5%)

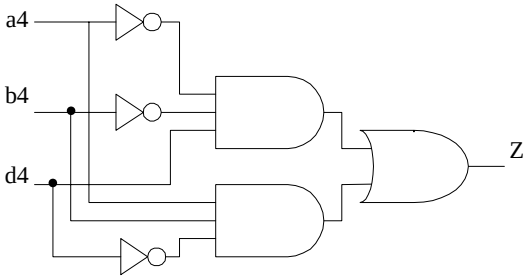
A-B' = A+(B')' = A+B (2%)



(3%)

(b) (5%)

Z = a4'b4'd4 + a4b4d4'



(c) (5%)

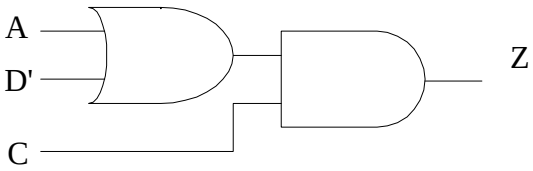
(A-(B'))' = (A+(B')*)' = (A+(B')*)*-1 = A*+B'-1 = **A'+B' ≠ A+B**

5. (10%)

(a) (5%) ∑m(2,6,10,11,14)+d(4,5,7,12,13,15)

(b) (5%) Z = C(A+D')

AB \ CD	00	01	11	10
00	0	0	0	1
01	X	X	X	1
11	X	X	X	1
10	0	0	1	1



Switching Circuits & Logic Design, Fall 2003
Midterm Solution

6. (13%)

(a) (3%)

cd \ ab	00	01	11	10
00	1	1	0	0
01	1	1	1	0
11	1	0	1	1
10	1	0	1	1

(b) (6%)

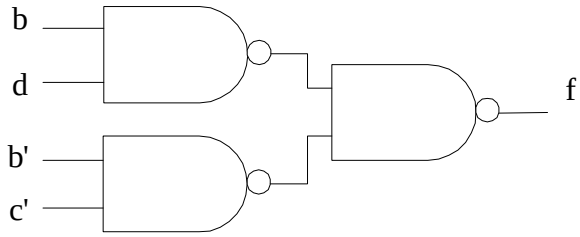
$$f = a'c' + ac + \{\begin{matrix} a'b' \\ b'c \end{matrix} + \{\begin{matrix} abd \\ bc'd \end{matrix}$$

(c) (4%)

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

7. (12%)

cd \ ab	00	01	11	10
00	X	0	0	1
01	1	1	X	X
11	0	1	X	0
10	0	0	0	0



$$f = bd + b'c'$$

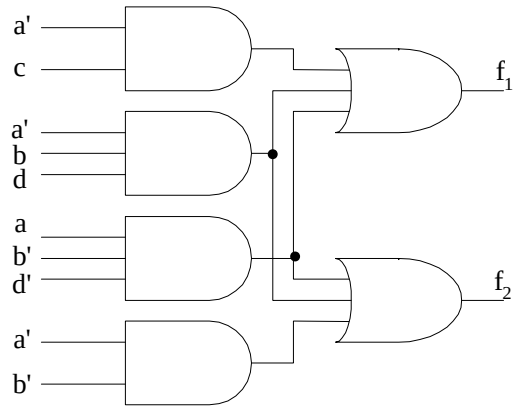
8. (10%)

cd \ ab	00	01	11	10
00	0	0	0	1
01	0	1	0	0
11	1	1	0	0
10	1	1	0	1

$$f_1 = a'c + a'bd + ab'd'$$

cd \ ab	00	01	11	10
00	1	0	0	1
01	1	1	0	0
11	1	1	0	0
10	1	0	0	1

$$f_2 = a'b' + a'bd + ab'd'$$



Switching Circuits & Logic Design, Fall 2003
Midterm Solution

9. (10%)

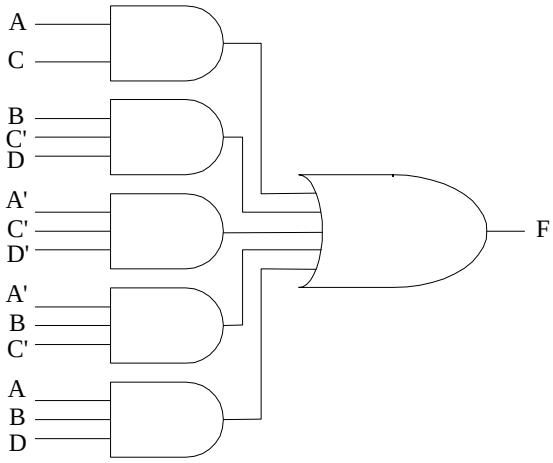
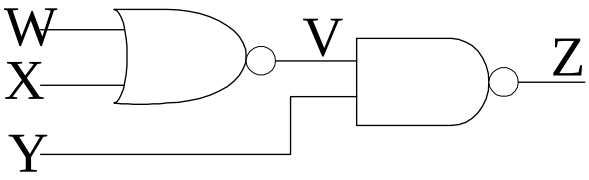
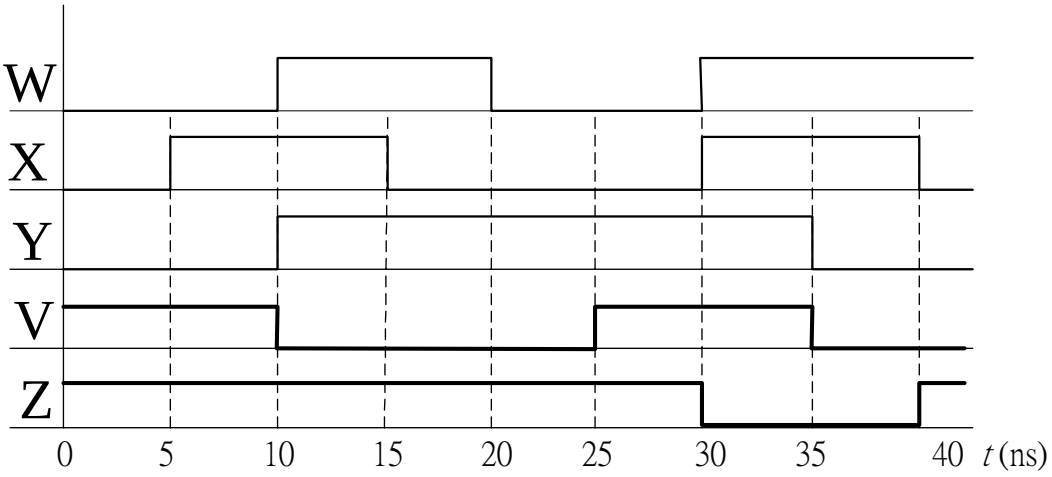
(a) (6%)

(A,B,C,D): (0101)→(0100) and (1111)→(1101)

(b) (4%)

CD \ AB	00	01	11	10
00	1	1	0	0
01	0	1	1	0
11	0	0	1	1
10	0	0	1	1

F = AC+BC'D+A'C'D'+A'BC'+ABD



10. (5%)