

Quiz 1 for CpE358/CS381 – Switching Theory and Logical Design Stevens Institute of Technology Summer 1, 2004 May 26, 2004	Name
Pledge:	
<p>This quiz is open book/open notes. PCs are permitted to lookup information in your notes for the course, but electronic communications with others in the class or outside is prohibited.</p> <p>Total value is 100 points (10% of course grade). All questions are equally weighted. Do any 5 of the 7 question. Do more than 5 for extra credit. Some question can be answered in more than one way. Only one answer is required, but extra credit will be given for identifying and explaining alternate answers. Some questions ask for N answers. Extra credit will be given for more than N answers.</p>	

(1) Convert the following unsigned numbers between decimal and binary:

- a. 47
- b. 96.5625
- c. 160
- d. 17.625
- e. 100001_2

$47 = 32+15 = 32+8+4+2+1 = 101111$ $96.5625 = 64+32+.5+.0625 = 1100000.1001$ $160 = 10*16 = 1010*10000 = 10100000$ $17.625 = 16+1+.5+.125 = 10001.101$ $100001 = 32+1 = 33$

(2) Convert the following numbers between signed decimal and 8-bit 2's complement:

- a. 10110010_2
- b. -18
- c. 10001001_2
- d. -102

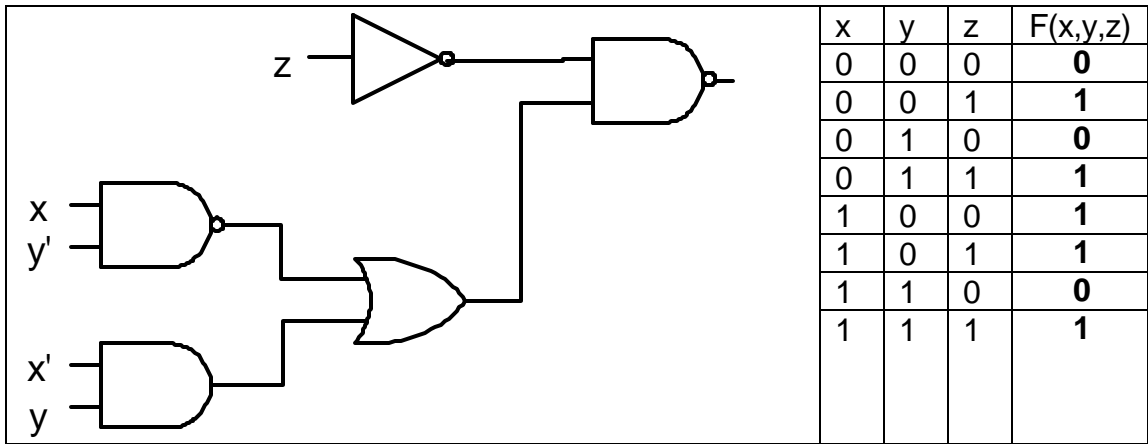
$10110010 \rightarrow 01001101+1 \rightarrow 01001110 = -(64+8+4+2) = -78$ $-18 \rightarrow -(16+2) \rightarrow -(00010010) \rightarrow 11101101+1 \rightarrow 11101110$ $10001001 \rightarrow 01110110+1 \rightarrow 01110111 \rightarrow -(7*(16+1)) \rightarrow -119$ $-102 \rightarrow -(64+32+4+2) \rightarrow -(01100110) \rightarrow 10011001+1 \rightarrow 10011010$

(3) Perform the following conversions

- $3BD6_{16}$ to octal
- 135407_8 to hexadecimal
- $F6E3_{16}$ to binary
- 1010.011_8 to hexadecimal

$3BD6_{16} = 11\ 1011\ 1101\ 0110 = 11\ 101\ 111\ 010\ 110 = 35726_8$
 $135407_8 = 001\ 011\ 101\ 100\ 000\ 111 = 00\ 1011\ 1011\ 0000\ 0111 = BB07_{16}$
 $F6E3_{16} = 1111\ 0110\ 1110\ 0011_2$
 $1010.011_8 = 001\ 000\ 001\ 000.000\ 001\ 001_2$
 $= 0010\ 0000\ 1000.0000\ 0100\ 1000_2 = 208.048_{16}$

(4) Find the truth table for the following logic diagram:



If z is TRUE, the output must be TRUE because of the output NAND
 $F(x,y,z) = (?,1,?,1,?,1,?,1)$
 Reduce the circuit to:

by pushing the inversion at the output NAND back to the OR
 If x is FALSE, the output of the NAND must be TRUE, so the output must be FALSE
 $F(x,y,z) = (0,1,0,1,?,1,?,1)$
 Likewise, if y' if FALSE (y is TRUE), the output of the NAND must be TRUE, so the output must be FALSE
 $F(x,y,z) = (0,1,0,1,?,1,0,1)$
 For the remaining case, $x=1, y=0, z=0$, so $x'y$ is FALSE and the output is TRUE
 $F(x,y,z) = (0,1,0,1,1,1,0,1)$

(5) Simplify the function $F(a,b,c)=b'c + ac' + bc$ by algebraic manipulation

$$\begin{aligned}
 F(a,b,c) &= b'c + ac' + bc \\
 &= c(b' + b) + ac' = c + ac' \\
 &= (c + ac) + ac' = c + a(c + c') \\
 &= a + c
 \end{aligned}$$

(6) Express the function $F(x,y,z)=xy' + z$ in terms of its minterms.

$$\begin{aligned}
 F(x,y,z) &= xy' + z \\
 &= xy'(z + z) + (x' + x)(y' + y)z \\
 &= xy'z' + xy'z + x'y'z + x'yz + xy'z + xyz \\
 &= xy'z' + x'y'z + x'yz + xy'z + xyz \\
 &= m_4 + m_1 + m_3 + m_5 + m_7 \\
 &= \sum (1,3,4,5,7)
 \end{aligned}$$

(7) Simplify the following Karnaugh map (covering 1's) and define the function it represents in terms of the combinatoric expression:

		cd		c	
		00	01	11	10
ab	00	1	0	1	1
	01	1	1	1	0
	11	1	0	1	0
	10	1	0	1	1
		d			

There are 4 possible answers covering the 1's with 4 regions. There is also an optional answer that covers the 0's with three regions.

The 1's-covering equations are:

$$F(a,b,c,d) = c'd' + cd + a'bc' + b'c$$

$$F(a,b,c,d) = c'd' + cd + a'bd + b'c$$

$$F(a,b,c,d) = c'd' + cd + a'bc' + b'd'$$

$$F(a,b,c,d) = c'd' + cd + a'bd + b'd'$$

The 0's covering equation is:

$$F'(a,b,c,d) = b'c'd + ac'd + bcd'$$

