The University of Alabama in Huntsville
ECE Department
EE 202 – 02
Fall 2010
Test 1 Solution

1. (1 point) The output of of a two input AND gate is 1 if _both_ of the inputs are 1.
2. (1 point).Definitions of logical operations may be listed in a compact form called _truth table_.
3. (1 point) A _literal_ is a single variable within a term, in complemented or uncomplemented form.
4. (1 point) A _register_ is a group of binary cells.
5. (1 point).For n bits, there are _2^n_ distinct combinations of 0s and 1s.
6. (10 points) Convert (2012_3) to decimal:

   $2012_3 = 2 \times 3^3 + 0 \times 3^2 + 1 \times 3^1 + 2 \times 3^0 = 2 \times 27 + 0 \times 9 + 1 \times 3 + 2 \times 1 = 54 + 0 + 3 + 2 = 59_{10}$

7. (5 points) Convert 11110001110001011101001110100111 to hexadecimal

$11110001110001011101001110100111_2 = 1111\ 0001\ 1100\ 0101\ 1101\ 0011\ 1010\ 0111_2 = F1C5D3A7_{16}$

8. (5 points) We can perform logical operations on strings of bits by considering each pair of corresponding bits separately (called bitwise operation). Given two eight-bit strings A = 10110001 and B = 10101100, evaluate the eight bit result after a NOR operation.

A =	1011 0001
B =	1010 1100
A NOR B =	0100 0010

9. (20 points) Convert decimal +25 and +62 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+25) + (-62). Convert the answer back to decimal and verify that it is correct.

2	62		2	25		2	43	
2	31	0	2	12	1	2	21	1
2	15	1	2	6	0	2	10	1
2	7	1	2	3	0	2	5	0
2	3	1	2	1	1	2	2	1
2	1	1		0	1	2	1	0
	0	1				2	0	1

+25 = 001 1001   +62 = 011 1110   -62 = -64 + 2   -62 = 100 0010

+25 = 001 1001   25 - 62 = -37
+(-85)= 100 0010

$101\ 1011 = 1 \times -2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= -64 + 0 + 16 + 8 + 0 + 2 + 1$
$= -37$ ✓

10. (5 points) Convert $F(A, B, C, D) = \Pi(0, 1, 5, 7)$ to the other canonical form.

$F(A, B, C, D) = \Sigma(2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15)$

11. (10 points) Formulate a weighted binary code for the decimal digits, using weights 5321

5	3	2	1	Digit
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	1	0	0	3
0	1	0	1	4
1	0	0	0	5
1	0	0	1	6
1	0	1	0	7
1	1	0	0	8
1	1	0	1	9

12. (10 points) Reduce A'C' + ABC + AC' to three literals.

$$
\begin{aligned}
A'C' + ABC + AC' &= A'C' + AC' + ABC && x + (y + z) = (x + y) + z \\
&= C'(A' + A) + ABC && xy + xz = x(y + z) \\
&= C' + ABC && x + x' = 1,\ x \cdot 1 = x \\
&= (C' + AB)(C' + C) && x + yz = (x + y)(x + z)
\end{aligned}
$$

13. (10 points) Find the complement of $z'(x + (y + z)x')$

$$
\begin{aligned}
(z'(x + (y + z)x'))' &= z + (x + (y + z)x')' && (xy)' = x' + y' \\
&= z + (x'((y + z)x')') && (x + y)' = x'y' \\
&= z + (x'((y + z)' + x))) && (xy)' = x' + y' \\
&= z + (x'(y'z' + x)) && (x + y)' = x'y' \\
&= z + x'y'z' + xx' \\
&= z + x'y'z' \\
&= (z + z')(z + x'y') \\
&= z + x'y'
\end{aligned}
$$

14. (20 points) Obtain the truth table of the following function, and express it in sum-of-minterms and product-of-maxterms form: $F = (x' + y + z')(x + y')(x + z) = \Sigma(1, 4, 6, 7) = \Pi(0, 2, 3, 5)$

x	y	z	x + y'	x + z	x' + y + z'	(x' + y + z')(x + y')(x + z)
0	0	0	1	0	1	0
0	0	1	1	1	1	1
0	1	0	0	0	1	0
0	1	1	0	1	1	0
1	0	0	1	1	1	1
1	0	1	1	1	0	0
1	1	0	1	1	1	1
1	1	1	1	1	1	1