The University of Alabama in Huntsville
ECE Department
EE 202 – 02
Fall 2013
Test 1 Solution
Fall 2013

$x + 0 = x$	$x \cdot 1 = x$
$x + x' = 1$	$x \cdot x' = 0$
$x + x = x$	$x \cdot x = x$
$x + 1 = 1$	$x \cdot 0 = 0$
$(x')' = x$	
$x + y = y + x$	$xy = yx$
$x + (y + z) = (x + y) + z$	$x(yz) = (xy)z$
$x(y + z) = xy + xz$	$x + yz = (x + y)(x + z)$
$(x + y)' = x'y'$	$(xy)' = x' + y'$
$x + xy = x$	$x(x + y) = x$

1. (1 point) The decimal number system is said to be of base, or _**radix**_, 10 because it uses 10 digits and the coefficients are multiplied by powers of 10.
2. (1 point).Positive integers (including zero) can be represented as _**unsigned**_ numbers.
3. (1 point) A _**gray**_ code is one in which only one bit in the code group changes in going from one number to the next.
4. (1 point) The _**duality**_ principle states that every algebraic expression deducible from the postulates of Boolean algebra remains valid if the operators and identity elements are interchanged.
5. (1 point) Boolean functions expressed as a sum of minterms or product of maxterms are said to be in _**canonical**_ form.
6. (10 points) Convert (36245_7) to decimal:

   $3 \times 7^4 + 6 \times 7^3 + 2 \times 7^2 + 4 \times 7^1 + 5 \times 7^0 = 3 \times 2401 + 6 \times 343 + 2 \times 49 + 4 \times 7 + 5 \times 1 = 9392_{10}$

7. (5 points) Convert 00101010011100101010001111001010100 1 to hexadecimal

   0010_1010_0111_0010_1010_0011_1100_1010_1001 = $2A72A3CA9_{16}$

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 an XOR operation.

   A 1011 0001
   B 1010 1100
   A ⊕ B 0001 1101

9. (20 points) Convert decimal +37 and +82 to binary, using the 8-bit signed-2's-complement representation. Then perform the binary equivalent of (-37) + (-82). Convert the answer back to decimal and verify that it is correct. Convert the answer back to decimal and verify that it is correct or explain why it is not.

+37 = 0 × -128 + 0 × 64 + 1 × 32 + 0 × 16 + 0 × 8 + 1 × 4 + 0 × 2 + 1 × 1 = 0010 0101
+82 = 0 × -128 + 1 × 64 + 0 × 32 + 1 × 16 + 0 × 8 + 0 × 4 + 1 × 2 + 0 × 1 = 0101 0010
-37 = 1 × -128 + 1 × 64 + 0 × 32 + 1 × 16 + 1 × 8 + 0 × 4 + 1 × 2 + 1 × 1 = 1101 1011
-82 = 1 × -128 + 0 × 64 + 1 × 32 + 0 × 16 + 1 × 8 + 1 × 4 + 1 × 2 + 0 × 1 = 1010 1110

-37 1101 1011
-82 1010 1110
1000 1001
1000 1001 =1 × -128 + 0 × 64 + 0 × 32 + 0 × 16 + 1 × 8 + 0 × 4 + 0 × 2 + 1 × 1 = -128 + 8 + 1 = -119 ✓

10. (5 points) Convert F(A, B, C, D) = Σ(0, 1, 2, 4, 7, 10, 13, 14) to the other canonical form.

F (A, B, C, D) = Π (3, 5, 6, 8, 9, 11, 12, 15)

11. (10 points) Formulate a weighted binary code for the decimal digits, using weights 8,-4,-2,1

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

12. (10 points) Reduce ABC'D + A'BD + ABCD to two literals using Boolean algebra.

F = ABC'D + ABCD + A'BD = ABD(C' + C) + A'BD = ABD + A'BD = BD(A + A') = BD

13. (10 points) Find the complement of (u + xw)(x + u'v).

F' = ((u + xw)(x + u'v))' = (u + xw)' + (x + u'v)' = u'(xw)' + x'(u'v)' = u'(x' + w') + x'(u + v')

14. (20 points) Draw the logic diagram corresponding to the following Boolean expression without simplifying it and obtain its truth table. F = (AB + A'B')(CD' + C'D)

A	B	C	D	AB + A'B'	CD' + C'D	F
0	0	0	0	1	0	0
0	0	0	1	1	1	1
0	0	1	0	1	1	1
0	0	1	1	1	0	0
0	1	0	0	0	0	0
0	1	0	1	0	1	0
0	1	1	0	0	1	0
0	1	1	1	0	0	0
1	0	0	0	0	0	0
1	0	0	1	0	1	0
1	0	1	0	0	1	0
1	0	1	1	0	0	0
1	1	0	0	1	0	0
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	0	0