Points missed: _____ Student's Name: ___________________________________

Total score: _____ /100 points

East Tennessee State University
Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization
TEST 1 for Fall Semester, 2003

Section 001

Read this before starting!

- The total possible score for this test is 100 points.
- This test is closed book and closed notes
- You may use one sheet of scrap paper that you will turn in with your test.
- You may NOT use a calculator
- **All answers must have a box drawn around them. This is to aid the grader (who might not be me!) Failure to do so might result in no credit for answer. Example:**

$$\boxed{32F1_{16}}$$

- **1 point will be deducted** per answer for missing or incorrect units when required. **No** assumptions will be made for hexadecimal versus decimal, so you should always include the base in your answer.
- If you perform work on the back of a page in this test, indicate that you have done so in case the need arises for partial credit to be determined.

"Fine print"

Academic Misconduct:

Section 5.7 "Academic Misconduct" of the East Tennessee State University Faculty Handbook, June 1, 2001:

"Academic misconduct will be subject to disciplinary action. Any act of dishonesty in academic work constitutes academic misconduct. This includes plagiarism, the changing of falsifying of any academic documents or materials, cheating, and the giving or receiving of unauthorized aid in tests, examinations, or other assigned school work. Penalties for academic misconduct will vary with the seriousness of the offense and may include, but are not limited to: a grade of 'F' on the work in question, a grade of 'F' of the course, reprimand, probation, suspension, and expulsion. For a second academic offense the penalty is permanent expulsion."

Basic Rules of Boolean Algebra:		
	1. $A + 0 = A$	**7.** $A \cdot A = A$
	2. $A + 1 = 1$	**8.** $A \cdot \overline{A} = 0$
	3. $A \cdot 0 = 0$	**9.** $\overline{\overline{A}} = A$
	4. $A \cdot 1 = A$	**10.** $A + AB = A$
	5. $A + A = A$	**11.** $A + \overline{A}B = A + B$
	6. $A + \overline{A} = 1$	**12.** $(A + B)(A + C) = A + BC$
DeMorgan's Theorem:	$\overline{(AB)} = (\overline{A} + \overline{B})$	$\overline{(A + B)} = (\overline{A}\ \overline{B})$

Short-ish Answer (2 points each)

1.) How many combinations of 1's and 0's can a 5-bit number (i.e., 5 binary variables) have?

a.) 15 b.) 16 c.) 31 d.) 32 e.) 63 f.) None of the above

2.) True or False: The expression $(A \bullet \overline{C}) + (\overline{B} \bullet C) + (\overline{A \bullet B \bullet C})$ is in correct Sum-of-Products form.

3.) Circle the function that would first be performed in the following expression.

$$A \cdot (B + C \cdot (D+E) + F)$$

4.) True or False: The number 1010111100101100011 is a valid BCD number.

5.) True or False: The 8-bit number 10010101_2 represents the same decimal value in unsigned binary as it does in 2's complement.

6.) What is the **minimum** number of bits needed to represent 64_{10} in signed magnitude representation?

a.) 5 b.) 6 c.) 7 d.) 8 e.) 9 f.) None of the above

7.) Which of the following is the lowest possible value for a 9-bit 2's complement binary number?

a.) 0 b.) -512 c.) -256 d.) -511 e.) -255 f.) -127 g.) None of the above

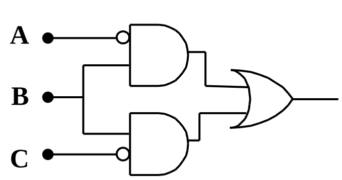
8.) Write the complete truth table for a 2-input NAND gate.

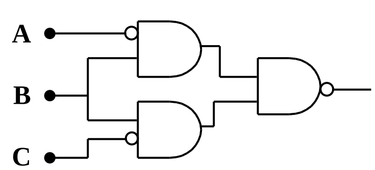
A	B	X

9.) For the truth table to the right, would a Product-of-Sums or a Sum-of-Products expression have fewer terms?

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

10.) True or False: The two circuits below are equal.





11.) True or False: An overflow has occurred in the 8-bit 2's complement addition shown to the right.

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 10011011
+01110000
 00001011
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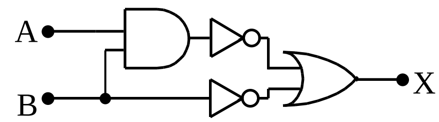
Medium-ish Answer (5 points each)

12.) Write the boolean expression exactly as it is represented by the circuit below. **Do not simplify!**



13.) Draw the circuit exactly as it is represented by the Boolean expression $(\overline{A} + B)\bullet\overline{C}$.

14.) Convert 1010111101111000101_2 to hexadecimal.

15.) Convert the decimal number 96404 to BCD.

16.) If an 8-bit binary number is used to represent an analog value in the range from 32 to 212, what is the accuracy of the system? In other words, if the binary number is incremented by one, how much change in the analog range is represented?

17.) If an 8-bit binary number is used to represent an analog value in the range from 0 to 100, what does the binary value 01100100_2 represent?

18.) Apply DeMorgan's Theorem to distribute the inverse to the individual terms of the following equation. **Do not simplify.**

$$\overline{D \cdot C \cdot B \cdot (A + B)}$$

19.) If a periodic binary signal has a period of 20 mS, how long must the logic ‘1’ pulse portion of the signal be for the signal to have a duty cycle of 25%?

Longer Answers (Points vary per problem)

20.) Determine the Sum-of-Products expression for this truth table. **Do not simplify.** (6 points)

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

21.) Complete the truth table below with the output from the Product-of-Sums equation shown. (5 points)

$$X=(\overline{A}+\overline{B}+C)\bullet(A+B+\overline{C})\bullet(\overline{A}+\overline{B}+\overline{C})$$

A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

22.) Fill in the blank cells of the table below with the correct numeric format. ***For cells representing binary values, only 8-bit values are allowed!*** If a value for a cell is invalid or cannot be represented in that format, write "X". Use your scrap paper to do your work. (2 points per cell)

Decimal	2's complement binary	Signed magnitude binary	Unsigned binary
	10010100		
		00110000	
			11000011

23.) Mark each equation as ***true*** or ***false*** depending on whether the right and left sides of the equal sign are equivalent. (3 points each)

a.) $(A \cdot B + C)(A \cdot B + D) = A \cdot B + C \cdot D$ Answer: ____________

b.) $\overline{(A \cdot B)} + B = 1$ Answer: ____________

c.) $\overline{A} \cdot \overline{B} \cdot \overline{C} + \overline{A} \cdot \overline{B} \cdot C + \overline{A} \cdot B \cdot \overline{C} + \overline{A} \cdot B \cdot C = \overline{A}$ Answer: ____________