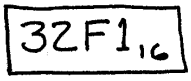
Points missed: _____ Student's Name: _____

Total score: _____ /100 points

East Tennessee State University – Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization – ***Section 001***
TEST 1 for Fall Semester, 2007

Read this before starting!

- The total possible score for this test is 100 points.
- This test is ***closed book and closed notes***
- ***Please turn off all cell phones & pagers during the test.***
- You may ***NOT*** use a calculator. Leave all numeric answers in the form of a formula.
- You may use one sheet of scrap paper that you must turn in with your test.
- 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:



- **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.
- Statement regarding academic misconduct from Section 5.7 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

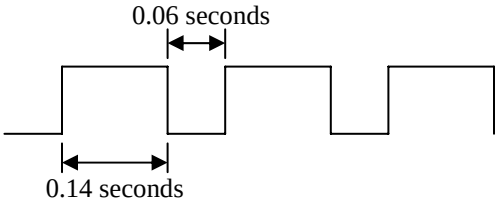
	OR	**AND**	**XOR**
Combined w/0	$A+0=A$	$A\cdot 0=0$	$A\oplus 0=A$
Combined w/1	$A+1=1$	$A\cdot 1=A$	$A\oplus 1=\overline{A}$
Combined w/self	$A+A=A$	$A\cdot A=A$	$A\oplus A=0$
Combined w/inverse	$A+\overline{A}=1$	$A\cdot\overline{A}=0$	$A\oplus\overline{A}=1$
Other rules	$A+A\cdot B=A$	$A+\overline{A}\cdot B=A+B$	$(A+B)\cdot(A+C)=A+B\cdot C$
DeMorgan's Th.	$\overline{(A\cdot B)}=\overline{A}+\overline{B}$		$\overline{(A+B)}=\overline{A}\cdot\overline{B}$

Short-ish Answer (2 points each unless otherwise noted)

1. Which unit of measurement is equivalent to (the same as) Hertz?

   a.) Cycles per second b.) Percent c.) Seconds d.) Seconds per cycle e.) Cycles

2. What is the frequency of the signal show to the right?



3. The duty cycle for the previous problem is:

   a.) greater than 50% b.) equal to 50% c.) less than 50%

4. How many patterns of ones and zeros can be made using 9 bits?

5. What is the most negative value that can be stored using a 9-bit 2's complement representation?

   a.) $-(2^7 - 1)$ b.) $-(2^8 - 1)$ c.) $-(2^9 - 1)$ d.) -2^7 e.) -2^8 f.) -2^9

6. Gray code is:

   a.) a numbering system designed to best represent the color levels of a gray scale image
   b.) a representation of binary that allows for quick conversion to and from decimal
   c.) a secret language spoken only by people from Gray, TN
   d.) a binary representation meant to improve the speed with which data is stored to memory
   e.) a sequence of numbers where only a single bit changes when incrementing or decrementing through the sequence

7. For each of the following applications, what would be the optimum (best) binary representation, unsigned binary (UB), 2's complement (TC), IEEE 754 Floating Point (FP), or binary coded decimal (BCD)? Identify your answer in the blank to the left of each application. (2 points each)

   _____ the distance above (positive) or below (negative) sea level in feet to the nearest integer

   _____ the number of atoms in a grain of salt (a really huge number)

   _____ the value in dollars and cents of a financial portfolio

8. Write the complete truth table for a 2-input NOR gate.

A	B	X

9. In the boolean expression below, circle the operation that would be performed first.

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

10. Multiply the 16-bit value 0000110111000000_2 by 8. ***Leave your answer in 16-bit binary.*** (Hint: Remember the shortcut!) (3 points)

11. Convert 1010010010010101011101_2 to hexadecimal. (3 points)

12. Convert the decimal value 86_{10} to 8-bit BCD.

13. Convert the unsigned binary value 11001_2 to its corresponding 5-bit binary Gray code. (3 points)

Medium-ish Answer (4 points each unless otherwise noted)

14. Convert the 32-bit IEEE 754 floating-point number 11000000110011100000000000000000 to its binary exponential format, e.g., 1.1010110 x 2^{-12}, (which, by the way, is not even close to correct).

15. Convert 11001.101_2 to decimal. (You may leave your answer in expanded form if you wish.)

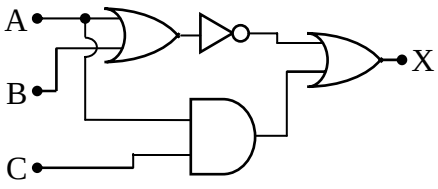
16. Draw the circuit ***exactly*** as it is represented by the Boolean expression $\overline{A+B}+A\cdot C$.

17. Prove that $A \oplus A = 0$. (Remember that $\oplus$ is the XOR or exclusive-OR)

18. Use any method you wish to prove the rule $A + \overline{A} \cdot B = A + B$. Show all steps.

19. In the space to the right, create the truth table for the circuit shown below.

A	B	C	



20. Write the Boolean expression for the circuit shown in the previous problem. ***Do not simplify!***

Longer Answers (Points vary per problem)

21. Assume that an 8-bit binary number is used to represent an analog value in the range from 0 to 30. Convert all four of the following binary values to their analog equivalent, i.e., what analog value does each of these binary values represent? (You may leave your answer in the form of a fraction in some cases if you wish.) (5 points)

    a.) 00000000_2

    b.) 00000001_2

    c.) 00001010_2

    d.) 11111111_2

22. Use DeMorgan's Theorem to distribute the inverse of the expression $\overline{A + B + \overline{C + D}}$ all of the way to the individual input terms. ***Do not simplify!***

23. Mark each Boolean expression as ***true*** or ***false*** depending on whether the right and left sides of the equal sign are equivalent. Show all of your work to receive partial credit for incorrect answers. (3 points each)

a.) $(A + B) \cdot (\overline{A} + \overline{B}) = A \cdot \overline{B} + \overline{A} \cdot B$ Answer: _____

b.) $(A \cdot B + C) \cdot (A \cdot B + D) = A \cdot B + C \cdot D$ Answer: _____

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

24. 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". (7 points per row)

Decimal	2's complement binary	Signed magnitude binary	Unsigned binary	Unsigned BCD
130				
	01000100			
		11000011		