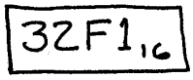
Points missed: _____ Student's Name: _____

Total score: _____ /100 points

East Tennessee State University – Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization
TEST 1 for Spring Semester, 2008

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. 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 versus binary, 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

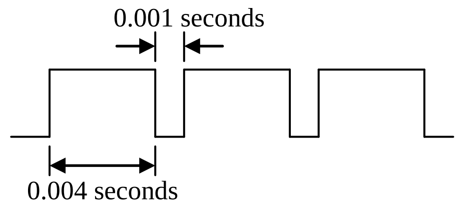
	OR	AND	XOR
Combined w/0	$A+0=A$	$A\cdot 0=0$	$A\oplus 0=A$
Combined w/1	$A+1=1$	$A\cdot 1=A$	$A\oplus 1=\overline{A}$
Combined w/self	$A+A=A$	$A\cdot A=A$	$A\oplus A=0$
Combined w/inverse	$A+\overline{A}=1$	$A\cdot\overline{A}=0$	$A\oplus\overline{A}=1$
Other rules	$A+A\cdot B=A$	$A+\overline{A}\cdot B=A+B$	$(A+B)\cdot(A+C)=A+B\cdot C$
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 used to represent the period of a periodic waveform?

   a.) Cycles per second b.) Percent c.) Hertz 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.) 0% b.) 20% c.) 40% c.) 50% d.) 60% e.) 80% f.) 100%

4. How many patterns of ones and zeros can be made using 6 bits?

5. What is the most positive value that can be stored using a 8-bit signed magnitude representation?

   a.) $2^6 - 1$ b.) $2^7 - 1$ c.) $2^8 - 1$ d.) 2^6 e.) 2^7 f.) 2^8

6. Which signed binary representation works for addition of both positive and negative values, signed magnitude or 2's complement?

7. True or false: A 4-bit ***Gray code sequence*** consists of 16 different patterns of ones and zeros.

8. True or False: The number 011001010111110010111 is a valid BCD number.

9. Is the IEEE-754 32-bit floating-point value 11111111000000001010101000000000 positive or negative?

10. Write the complete truth table for a 2-input NAND gate. (3 points)

A	B	X

The following two questions are based on the 8-bit binary addition shown below.

```
Carry out →  1  11100111
               +10010010
               ---------
                01111001
```

11. True or False: If the addition above is considered 8-bit 2's complement, an overflow has occurred.

12. True or False: If the addition above is considered 8-bit unsigned, an overflow has occurred.

13. In the boolean expression below, circle the ***single*** operation that would be performed first.

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

14. Divide the 16-bit value 0000110111000000_2 by 16. ***Leave your answer in 16-bit binary.*** (Hint: Remember the shortcut!)

15. Convert 1100100001101111011112 to hexadecimal.

16. Convert the unsigned binary value 10101_2 to its corresponding 5-bit binary Gray code. (3 points)

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

17. Convert the 32-bit IEEE 754 floating-point number 01000001100011100000000000000000 to its binary exponential format, e.g., 1.1010110 x 2^{-12}, (which, by the way, is not even close to correct).

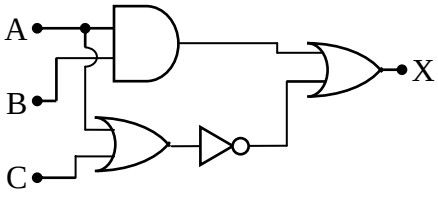
18. Convert 1100.011_2 to decimal. (You may leave your answer in expanded form if you wish.)

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

20. Prove that $A \oplus 1 = \overline{A}$. (Remember that $\oplus$ is the XOR or exclusive-OR) For full credit, please show all steps in detail.

21. Use any method you wish to prove the rule $A \cdot B + \overline{A} \cdot B = B$. For full credit, please show all steps.

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



A	B	C	

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

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

25. Assume that an 8-bit binary number is used to represent an analog value in the range from 20 to 95. 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.)

    a.) 00000000_2

    b.) 00000001_2

    c.) 00000110_2

    d.) 11111111_2

Longer Answers (Points vary per problem)

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

b.) $\overline{A}B\overline{C}D + A\overline{C}DE + \overline{C}D\overline{E} + \overline{C}DE = \overline{C}DE$ Answer: _____

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

27. 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
24				
		11000110		
	00100110			