

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, 2005

Read this before starting!

- The total possible score for this test is 100 points.
- This test is ***closed book and closed notes***
- 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:

32F1₁₆

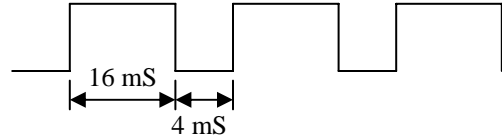
- **1 point will be deducted** per answer for missing or incorrect units when required. **No** assumptions will be made for hexadecimal versus decimal, so you should always include the base in your answer.
- If you perform work on the back of a page in this test, indicate that you have done so in case 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 plagiarizing, the changing or 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. $A + \overline{A}B = A$
	5. $A + \overline{A} = 1$	11. $A + \overline{A}B = A + B$
	6. $\overline{\overline{A + B}} = \overline{\overline{A}} + \overline{\overline{B}}$	12. $(A + B)(A + C) = A + BC$
DeMorgan's Theorem:	$\overline{(AB)} = \overline{A} + \overline{B}$	$\overline{(A + B)} = \overline{A} \cdot \overline{B}$

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

1. What is the frequency of the periodic signal in the figure shown to the right? **Be sure to include your units!**
(Note: mS means milliseconds = 10^{-3} seconds)



2. What is the duty cycle of the periodic signal from problem 1?
3. How many combinations of 1's and 0's can a 9-bit number (i.e., 9 binary variables) have?
a.) 2^{9-1} b.) $2^9 - 1$ c.) 2^{9+1} d.) 2^9 e.) $2^{9-1} - 1$ f.) None of the above
4. For each of the following binary representations, give the decimal expression for the smallest/lowest value that can be represented using 7 bits. (2 points each)
- a.) unsigned binary:
- b.) 2's complement:
- c.) signed magnitude:

5. True or False: The number 1110101100101100111 is a valid BCD number.
6. True or False: The inversion bar (NOT operation) in boolean algebra is equivalent to an algebraic negative sign.
7. True or False: True or False: The binary floating-point number 01101101101011001101000011001001 is negative.
8. Write the complete truth table for a 2-input XOR gate (3 points).

A	B	X

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

$$\begin{array}{r}
 \text{Carry out} \rightarrow 1 \quad 11100010 \\
 + 00110010 \\
 \hline
 00010100
 \end{array}$$

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

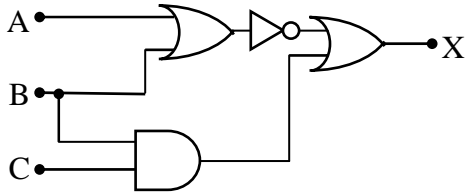
11. Multiply 00010100_2 by 4. Leave your answer in binary. (Hint: There is a shortcut.) (3 points)
12. If an entire digital system could be created using only one type of gate, which gate should it be?
 a.) AND b.) OR c.) XOR d.) NAND e.) NOR f.) Exclusive NOR
13. Circle the function that would first be performed in the following expression.

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

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

14. Convert the BCD number 100101010001 to decimal.
15. Convert the floating-point number 01000000111011000000000000000000 to its binary exponential format, e.g., 1.1010110×2^{-12} , (which, by the way, is not even close to the right answer).
16. Convert 0101.0100 to decimal. (You may leave your answer in expanded form if you wish.)
17. Draw the circuit ***exactly*** as it is represented by the Boolean expression $A + B + \overline{C + D}$
18. Convert 1011101111010101001_2 to hexadecimal.
19. Use any method you wish to prove rule 10: $A + A \cdot B = A$. Show all steps.

20. In the space to the right, create the truth table for the circuit shown below. (5 points)



A	B	C	

21. Write the Boolean expression for the circuit shown in the previous problem. *Do not simplify!*
22. If an 8-bit binary number is used to represent an analog value in the range from -5 to 5 , how large an analog value does a single binary increment represent? In other words, if the binary number is incremented by one, how much change in the analog range is represented? (Leave your answer in the form of a fraction.)
23. Use DeMorgan's Theorem to distribute the inverse of the expression $\overline{A \cdot B + C \cdot D}$ to the individual input terms. *Do not simplify!*

Longer Answers (Points vary per problem)

24. 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.) $(A + B) \cdot (B + \bar{A}) = B$ Answer: _____

b.) $A \cdot \bar{B} \cdot C + \bar{A} \cdot B \cdot C + A \cdot B \cdot C + \bar{A} \cdot \bar{B} \cdot C = C$ Answer: _____

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

25. 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
		01101010	
-74			
91			