

Points missed: _____

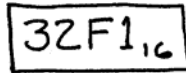
Student's Name: _____

Total score: _____/100 points

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

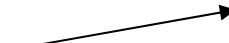
Basic Rules of Boolean Algebra

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

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

1. What is the period of a signal with a frequency of 125 MHz? **Be sure to include the appropriate units for period!** (Note: MHz means Megahertz = 10^6 Hertz)
2. If the period of a pulse train is 100 mS and its duty cycle is 30%, what is the signal's pulse width?
3. How many patterns of ones and zeros can be made using 12 bits?
4. What is the most positive value that can be stored using a 12-bit 2's complement representation?
a.) $2^{10} - 1$ b.) $2^{11} - 1$ c.) $2^{12} - 1$ d.) 2^{10} e.) 2^{11} f.) 2^{12}
5. What is the **minimum** number of bits needed to represent 512_{10} using unsigned binary representation?
a.) 6 b.) 7 c.) 8 d.) 9 e.) 10 f.) 11
6. 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)
_____ Avogadro's number ($6.02214199 \times 10^{23}$)
_____ Temperature in degrees (rounded to nearest integer)
_____ A person's weight (rounded to the nearest integer)
7. True or False: The **magnitude** of the 32-bit IEEE 754 floating-point number $1100011010010011101101101011001$ is greater than 1, i.e., the exponent is a non-negative value.

A	B	X

8. Write the complete truth table for a 2-input XOR gate. 
9. Divide the 16-bit value 0000011010100000_2 by 8. **Leave your answer in binary.** (Hint: Remember the shortcut!) (3 points)

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

$$A + B \cdot C$$

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

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

12. Convert 00010101101000011_2 to hexadecimal. (3 points)

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

13. Convert the 32-bit IEEE 754 floating-point number $10111110010011001011000000000000$ to its binary exponential format, e.g., 1.1010110×2^{-12} , (which, by the way, is not even close to correct).

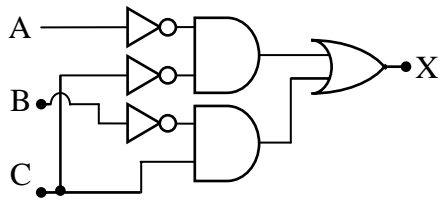
14. Convert 1011.011_2 to decimal. (You may leave your answer in expanded form if you wish.)

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

16. Prove that $A \oplus 1 = \overline{A}$. (Remember that \oplus is the XOR or exclusive-OR)

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

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



A	B	C	

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

20. Use DeMorgan's Theorem to distribute the inverse of the expression $\overline{(A + \overline{B}) \cdot C}$ to the individual input terms. **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 25. 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.) 00000000₂
- b.) 00000001₂
- c.) 01010000₂
- d.) 11111111₂

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

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

c.) $B \cdot C + \bar{B} + \bar{C} = 1$ Answer: _____

23. 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
		11010011		
			01010100	
-96				